THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXII. No. 1834.] LONDON, JULY 5, 1898. [50TH YEAR. PRICE 6d.

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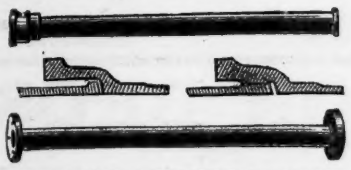

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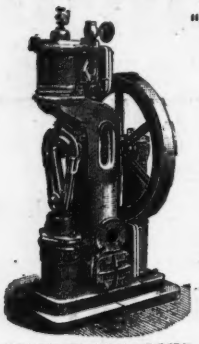


Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

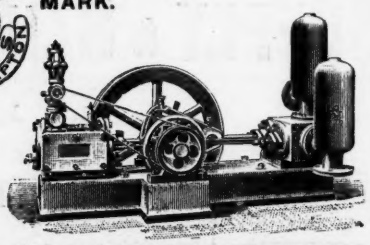


Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

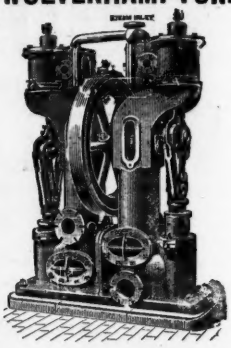
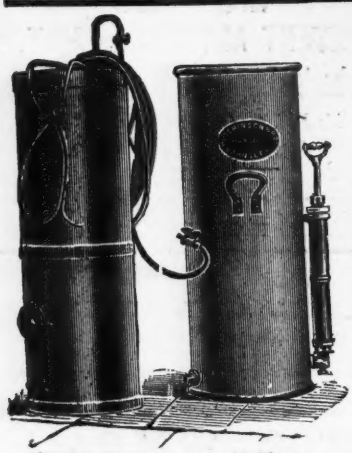


Fig. 712 "DOUBLE-RAM" STEAM-PUMP.



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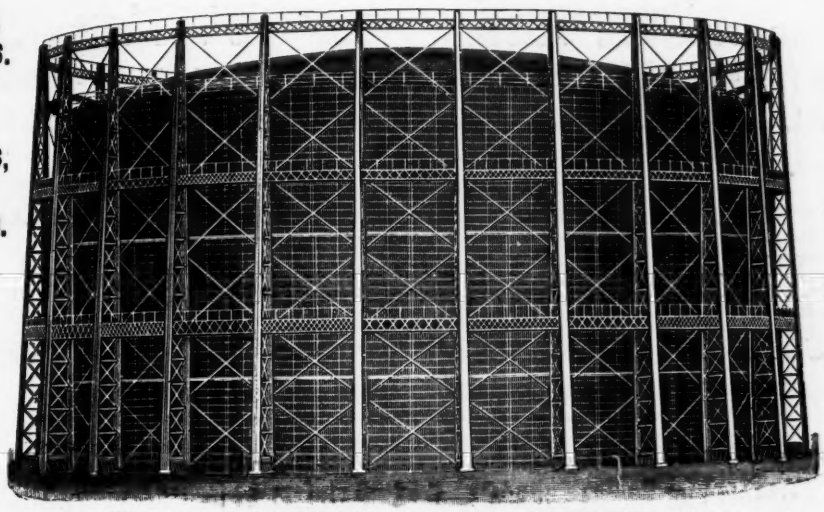

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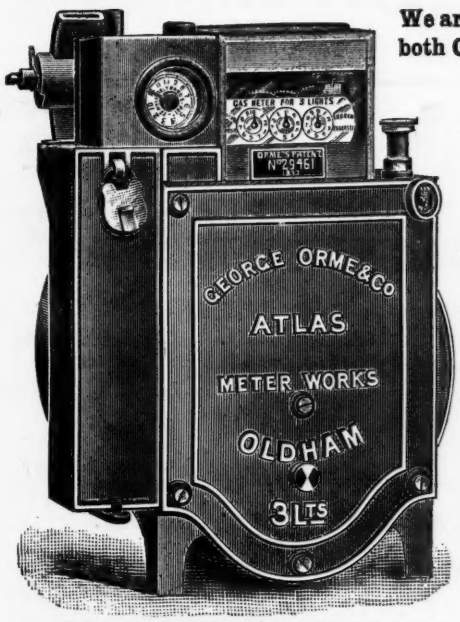

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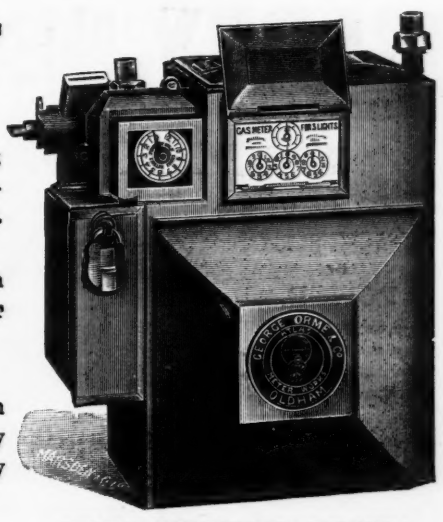

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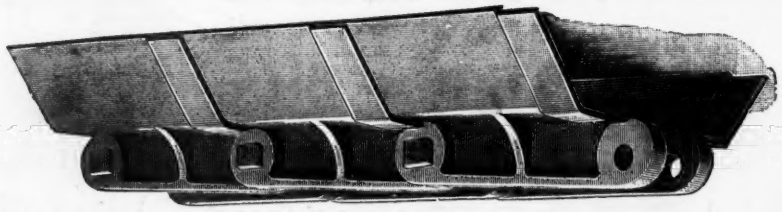

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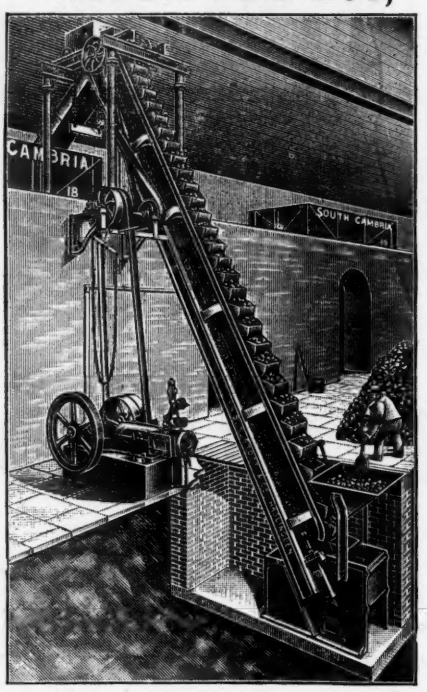

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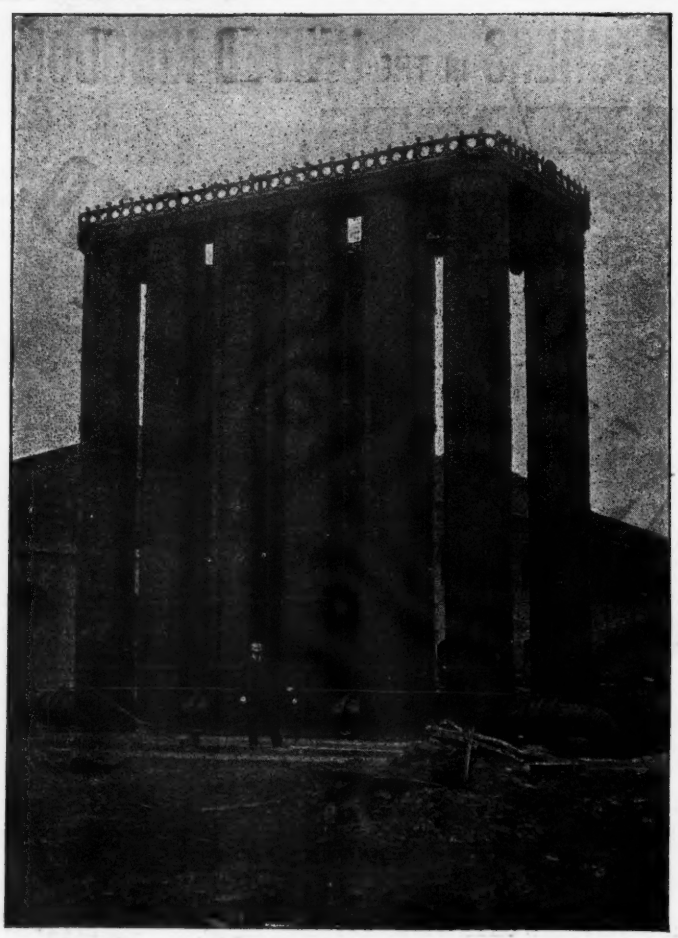

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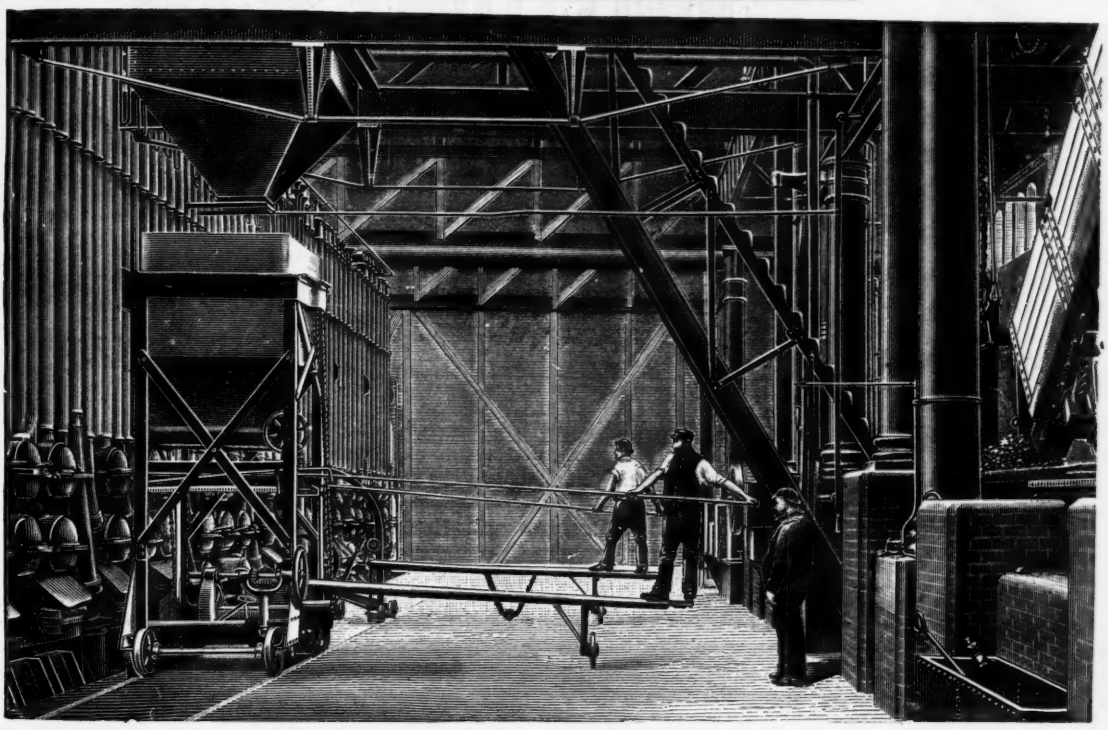

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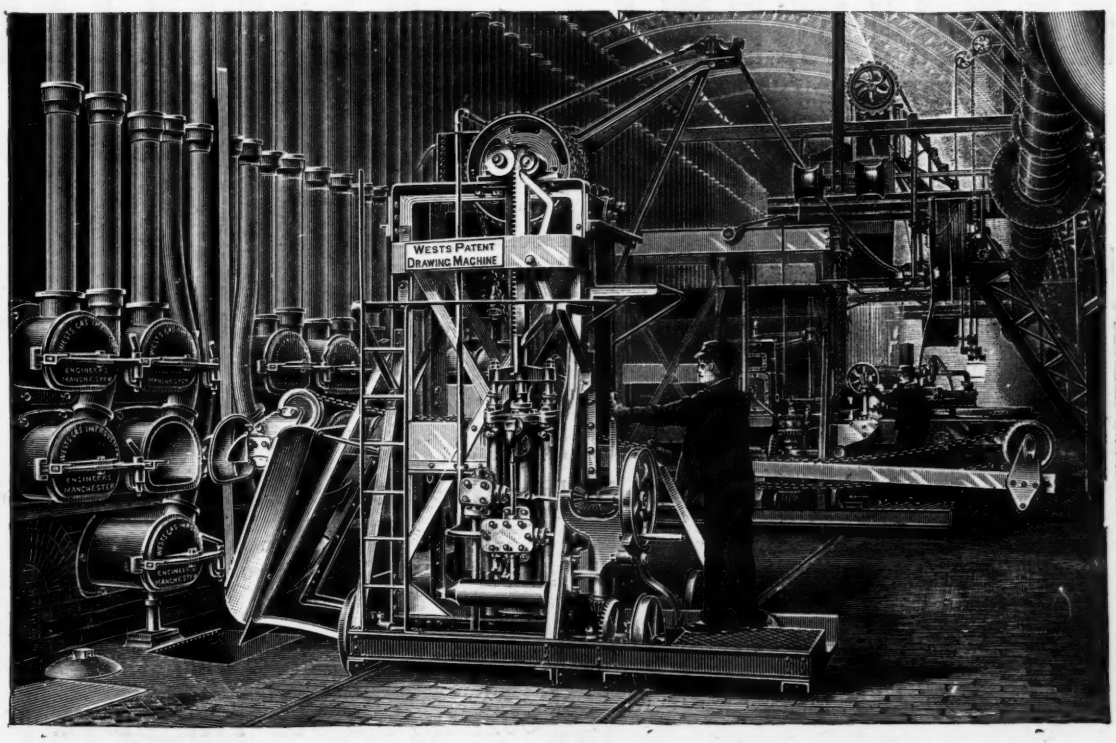

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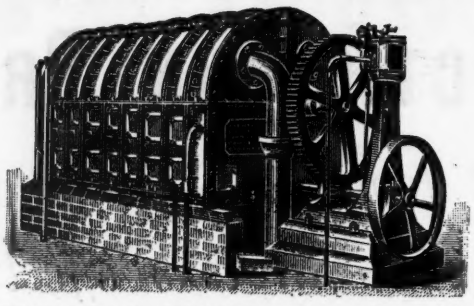

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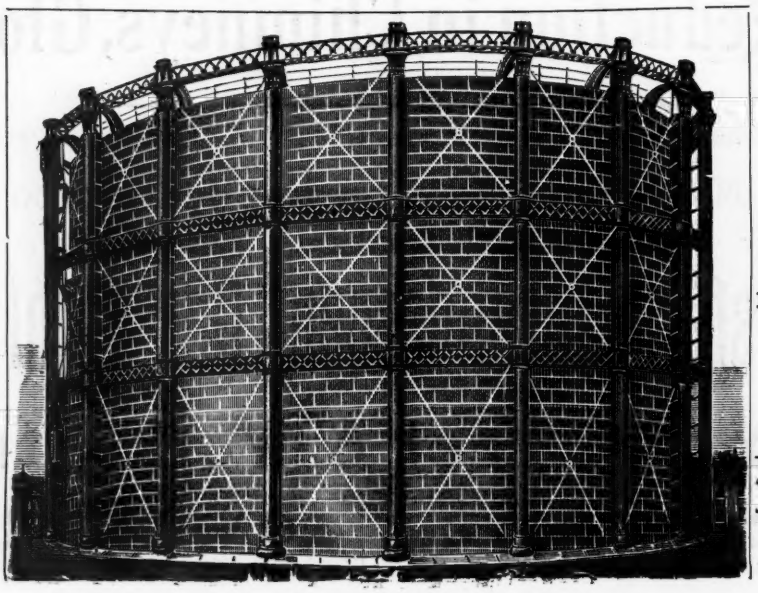

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Norwich	1,000,000	North Middlesex	150,000
Holyoke, Mass.	600,000	Wandsworth and Putney	1,800,000
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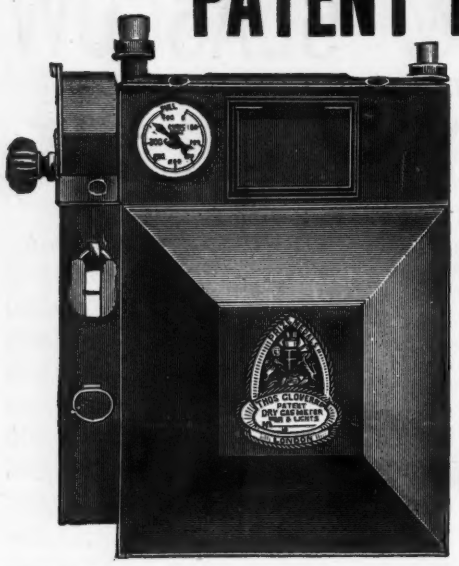

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EDITORIAL NOTES.

Workmen's Compensation—The Rules of Procedure.

THE Workmen's Compensation Act came into force on Friday, the 1st inst.; and henceforward all the greatest industries of the kingdom, including gas manufacture on all but the smallest scale, will be carried on under entirely novel conditions. The nature of these is only slightly sketched by the paper and the discussion on the subject which formed part of the transactions of the recent meeting of The Gas Institute. During the week just past, of course, all the newspapers have been instructing their readers more or less sensibly respecting the character and bearings of the new law. The most striking feature of the bulk of this newspaper criticism is the general confession of ignorance as to how the new Act will work in practice. The organs of the Opposition naturally find fault with it all round. Thus the "Daily News" has a grumble over the delay in bringing the Act into operation; and also over the exclusion of agricultural labourers, domestic servants, and workshops from its provisions. These complaints were dealt with while the Bill was passing through Parliament; and it is waste of time to argue over them now. In a leading article on the subject, "The Times" more profitably discusses what the Act does, or intends to do. It is first pointed out that the benefits of the Act of 1897 are not restricted, as in the case of the Employers' Liability Act, 1880, to persons engaged in manual labour. The novelty and gravity of the new statute are rightly held to consist in the fact that it does what never before was done under any system of law—"it makes, broadly speaking, an "employer liable for all accidents, whatever their cause." Another important innovation is that the superior employer cannot get rid of his liability by sub-letting the work, when the sub-contractor is in the same line of business. It is sagely remarked that one of the objects of the framers of the Act was to do away with the occasion for the petty litigation which so greatly marred the usefulness of previous legislation. "In this respect there is likely to be "disappointment." Where there is no common understanding between employers and employed, the opportunities for litigation will remain open as before. The workman's rights at common law continue; and the Employers' Liability Act is unrepealed. "There are good "reasons why an injured workman should often seek in "the first instance his remedy under the old Act." This is a view that the militant Trade Unions may be relied upon to favour. In cases of disablement, it is possible to get larger compensation under the Act of 1880 than under that of 1897. Under the former, a sufferer with a very clear case "may recover damages not exceeding the esti-"mated earnings during the last three years of a person in "the same grade, which might be considerably more than "the maximum provided by the new Act." The plaintiff, moreover, would have the advantage of trying his luck with a sympathetic jury, instead of an arbitrator. Again, under the old Act, the compensation is handed over without restriction, whereas the Committee or the Arbitrator under the new Act might decide to invest it for the sufferer's benefit. And if he fails under the Act of 1880, a plaintiff may still ask the Judge of the Court in which he sues to assess damages under the new Act. "It is unfor-"tunate," observes "The Times," "that the confusion "which existed before the new Act is not removed, but "made worse. Such, however, is the fact." Mr. Willis, in his little handbook, agrees that the state of the law is anything but clear in this regard.

Now we have to draw our readers' attention to the statutory "Rules" recently issued for carrying the Act into effect. These Rules came into existence without many people being aware of the fact. They are published by the Queen's Printers under the title of "Master and "Servant—The Workmen's Compensation Rules, 1898, "dated May 27, 1898," and are actually in force. It is incumbent upon every employer under the Act to procure a copy of this official publication. The Rules are much longer than the Act itself; and it is little short of a scandal that they have not been issued long before this. They are positively alarming. As "The Times" justly remarks: "In the discussion of the measure in Parliament, there "were many airy references to the untechnical, free-and-"easy manner in which all questions would be disposed "of. The new Rules do not encourage one to think that

"those hopes will prove true. They describe a system so "intricate that legal assistance will be almost always "necessary." Of course, the Rules are only to prescribe the procedure in disputed cases. Still it is cheerfully predicted that "employers must be prepared to endure a "good deal of profitless worry for some months after the "Act takes effect." The prospect is not one of peace, where there is not good-will among men and masters.

The Thanet Gas Company's Act.

THE Thanet Gas Bill was mentioned in this column on May 24, on the occasion of its rejection by the House of Lords Committee. It was then stated that there was a chance of the Bill being recommitted, which was, as a matter of fact, done in due course; and on Friday of last week the Bill, as reconsidered and amended, was one of a batch to receive the Royal Assent. Pressure of other matter has prevented our noticing these later fortunes of the parliamentary aspirations of the Thanet Gas Company; but it is desirable, now that an Act has been secured—though not the one the promoters of the Bill originally hoped to obtain—to place on record the manner in which Parliament has dealt with the needs and desires of the Margate undertaking. The Bill as deposited contained a number of distinct proposals, the general nature of which was described in the issue of the "JOURNAL" for the 18th of January. The opposition of the Corporation of Margate was concentrated upon the projected compulsory acquisition of land for erecting new gas-works in a situation adjoining their water-works; and the Committee gave ear to this complaint. The promoters, however, were prepared to make some sacrifices to save the financial part of their Bill; and, failing to obtain from the Committee any indication of what should be dropped, they entered into negotiations with their opponents which had the happiest result. The Corporation were brought to agree to the Bill being recommitted by being given their own way as regards the question of the new gas lands; by the illuminating power of the gas being made 15 candles; and by receiving 5 per cent. discount on the public lighting account. These particulars of the settlement come to will be found in our "Parliamentary Intelligence" to-day.

It cannot be denied that the Corporation of Margate have scored heavily against the Gas Company's Bill; but, on the other hand, it is impossible to repel the suspicion that the Company took up from the first an untenable position. The proposal to erect new gas-works on a site offering a *primâ facie* case for the likelihood of pollution of the subsoil by percolation, was flying in the face of the earthly Providence represented by a Parliamentary Committee. The promoters were early made to feel this; and they approached their opponents with an offer of preventive precautions which only went to show that there was something to be guarded against. It was remarked in our last notice of these proceedings that this rock upon which the Bill split "is a matter that requires a deal more "consideration from gas managers than it has usually "received." We referred, of course, to pollution of the subsoil by gas manufacturing and distributing operations. Enormous expense and trouble have been caused to gas undertakings before now by this undesirable "residual "product" of their works; as the experience of Edinburgh —to cite only one instance—is quite sufficient to prove. Some modern improvements effected in gas manufacture are not, unhappily, in the direction of reducing the risk of this kind of nuisance. The Thanet Company are relieved, by what may prove eventually to be the kind severity of the Legislature, from working out another experience like that with which the old Edinburgh Company were familiar. Hence the question will not be discussed with reference to the integrity of the Margate water supply. Speaking generally, however, the problem is a grave one; and the risk of getting involved in a lawsuit of this kind is one from which the wealthiest gas company may fervently pray to be preserved.

The Petroleum Committee and the Flash-Point.

THE labours of the Petroleum Committee are not concluded; and it is therefore still doubtful how far the existing practice in regard to the transport, storage, and use of mineral oil will appear to this body to be susceptible of improvement. Having decided, by a majority of one, that the flash-point of burning oil should be raised to 100°, it was suggested to the Committee by the Scotch members that nothing further need be done to protect the public interest. The idea did not commend itself to the majority; and accordingly it is understood that the trade in even Scotch oil will be reported to be deserving of regulation of some sort, which is hardly what this particular trade interest desired. It was stated in the "JOURNAL" a fortnight ago that the Chairman of the Committee, Mr. Jesse Collings, was in favour of the suggestions for the improvement of lamps offered by Mr. J. W. Bernard Wright, the President of the Lamp and Stove Trades' Association of the United Kingdom. This gentleman has since written to "The Times" protesting that the first of these recommendations, which embodied the views of the members of the Association, was for the raising of the flash-point to 100° Abel test. This opinion was ignored by the Chairman. In repeating it, Mr. Wright uses the best argument for raising the flash-point that has yet been published. The writer says that "in those districts of the United "Kingdom where a high-flashing oil is used—namely, oil "having a flashing-point of over 100°—accidents with "lamps are almost unknown, whereas in those dis- "tricts where practically nothing but low-flash oil is used, "that is, oil at 73° test, accidents are most numerous." Again, he asks how, save by raising the flash-point, are the enormous number of lamps, to be reckoned by many millions, now in use in this country, to be made more safe than they are at present? Unfortunately, Mr. Wright is uncertain as to the effect of raising the flash-point upon the price of the oil; but he acknowledges that this is a subject in which the Scotch oil producers are pecuniarily interested. It is not to the Scotch but to the Russian product, however, that the writer looks to supply the market with high-flash oil at no advance on common American oil values.

How difficult it is to see one's way to a sensible conclusion from all these arguments, from few of which is the element of trade interest wholly absent! As to Mr. Wright's statement respecting the greater safety of oil users in high-flash districts, is not this observation open to correction with respect to the quantity of the different oils consumed? If there is ten times the quantity of American oil burnt (say) in London of the whole consumption of Scotch oil in Edinburgh, should we not be prepared to find everything else about it in the same proportion? Is it quite certain, also, that the great majority of the lamps actually in nightly use throughout the United Kingdom would be rendered sensibly safer by having them all charged with high-flash oil? Mr. Wright declares that "for all practical purposes it may be assumed "that the lamps in general use in this country, if used as "they are intended to be used, are safe." What evidence is there to prove that these lamps would be safer, in the ordinary way, with high-flash oil; or that the improper use of a lamp, with any grade of mineral oil, is safe? What of the *Goliath* fire, and the lamp accident by which Lord Romilly lost his life? If a single accident can happen with a high-flash oil, the whole case of those who would upset the existing order of things in the trade breaks down. We are only concerned to show that those who pretend that oil-lamps can ever be rendered safe by the expedient of raising the flash-point of the oil would lull the public into a "Fool's Paradise."

The Blocking of Streets by Central Lamp-Posts.

THE English people are, and must ever be, the despair of persons of a logical turn of mind. They are so sadly unsystematic, especially in matters of government. The British Constitution, the common law, and the English language itself, are representative, in their lack of definite form and order, of every other working of the national spirit. To descend from the general to the particular, let us consider the hap-hazard fashion in which the streets of English towns are lighted. Is there any rule for the disposition of street-lamps, the quantity of the light afforded by them, or even as to what authority is to have the arrangement of this public service? Not at all. Here a County Council, there a City Corporation, elsewhere a Vestry regulate this business for London; and throughout the country the variations and distinctions between the supplying and controlling agencies in the service are endless. The general public take no heed of these things until some especially remarkable piece of practice compels notice; and then people inquire in surprise whether there is no "rule" for such things. Just now the blocking of the London

streets by the ever-growing traffic is the subject of correspondence in a daily newspaper; and, in the course of this discussion, the Marquis of Granby has condemned in the strongest manner the latest fashion in street lighting by electric arc lamps. We have already, on more than one occasion, offered the opinion that the fashion is quite wrong, from the point of view of the needs of users of the streets; and now Lord Granby declares that "the system "of electric lighting which now obtains in London should "never have been allowed by the Local Authorities. The "plan adopted is that of placing the electric lamp-posts "on small 'islands' down the centre of the street." The effect of this arrangement is in some instances to reduce by one-third the carrying capacity of a main road. While this subject is being thus ventilated, the London County Council have had under consideration a new set of regulations for dealing with the overhanging lamps, signs, and other structures by which the proprietors of public-houses, and advertising shopkeepers generally, seek to render their premises conspicuous. It is proposed, among other things, that the sanction of the Local Authority shall be required for every lamp so fixed as to overhang the public way; and that when such lamps are sanctioned, they must be kept lighted during a prescribed number of hours. What is to be the penalty for disobedience to such orders, or how it is to be enforced, does not appear. It is understood that the new code of regulations will only be put in force if they receive the approval of each of the Metropolitan Highway Authorities.

Appointment of a "Conciliator" for South Wales.

It was announced at the end of the week that a step, which may prove to be an advance towards a settlement, had been taken with regard to the South Wales coal strike. In response to the approaches of the men's Provisional Committee, the President of the Board of Trade has invited Sir Edward Fry to act as Conciliator in the dispute, under the provisions of the Conciliation Act. Sir Edward has accepted the invitation; and consequently it is to be expected that before long both employers and employed will have an opportunity of proving before him the reality of their desire to terminate their differences. The experiment now to be tried will be extremely interesting. The Conciliator will have no compulsory powers; but in the present case he is endowed with high prestige. In the letter notifying the appointment to Mr. Wm. Abraham, Mr. Ritchie lays emphasis on the fact that if the Conciliator is to do anything, he must be sure that the men's representatives are really possessed of full and unlimited authority to discuss and settle the present difficulties. What is to happen after this condition is satisfied, nobody can say. The employers will probably bide their time, and see what the Conciliator can do with the men. Whatever else the appointment means, it cannot signify that Sir E. Fry is to act as Arbitrator between two disputants. "A conciliator's "business is to bring about peace if he can, and to pursue "it with a single eye." In this case, it will need a pretty keen eye to enable the Conciliator to keep from doing more harm than good. Meanwhile, the shortness of steam coal is being felt wherever the South Wales staple has hitherto found its market. Few dwellers in London and the South of England knew before this interruption in the trade how much these districts were dependent for inoffensive factory chimneys, locomotives, and steamboats, upon the regular supply of Welsh smokeless fuel. There have been whole weeks of this backward summer when London has been plunged in a sooty gloom that has suggested the atmospheric conditions of the industrial North, rather than those habitual in the valley of the Thames. Prosecutions for smoky chimneys have been plentiful; yet they might have been multiplied indefinitely had the police been stricter. The conditions thus created have been good for the gas coke market; but, though it is an ill wind that blows good to nobody, gas manufacturers will be as glad as anybody to hear that peace has been restored to the distracted South Wales region.

The Sutton Gasholder and Tank.

With the present number of the "Journal" is issued the last of the series of plates giving details of the tank and three-lift gasholder designed for the Sutton Gas Company by Mr. F. Southwell Cripps, Assoc.M.Inst.C.E., their Consulting Engineer, and now being constructed under his superintendence by Messrs. C. & W. Walker, of Donnington, and Messrs. B. Cooke and Co., of London. As our readers are aware, the drawings have been accompanied each week by descriptive notes by Mr. Cripps, not confined to the matter more immediately concerned, but on gasholder construction generally. In bringing the series to a close, it should be pointed out that, though the drawings have been published as examples of modern construction as applied to a gasholder of moderate size required for a particular place, it by no means follows that they would be equally suitable for a similar holder to be put up anywhere else. What has been done for Sutton is believed to be the best that could have been accomplished; but it must not be assumed that it is necessarily the best that could be done elsewhere. So much depends upon the actual conditions and circumstances of each individual case, that it is unwise to follow blindly any particular design. Sutton is, in fact, a case in point. When the construction of a holder there was under consideration, designs were submitted which had been copied from a holder erected in another town; and though these were excellent in their way, and exactly suited to the place for which they had been prepared, it was felt that the conditions obtaining at Sutton were not such as to make them the most suitable there. It was the close acquaintance with these conditions possessed by the Company's Consulting Engineer which led to the preparation of the new set; and it may be added that his intimate knowledge of all the constructional details of the work and the cost of carrying it out resulted in a saving of at least £750 in first cost. This fact is cited as an example of the economy resulting from adapting a good general design to special circumstances.

WATER AND SANITARY AFFAIRS.

An interesting debate took place in the House of Lords last week, on the motion for the third reading of the Rochdale Corporation Water Bill. The Earl of Crewe moved that the Bill should be re-committed, in order to give the County Council of the West Riding of Yorkshire an opportunity of being heard in opposition to the measure. The Select Committee to whom the Bill was referred had objected to hear the Council, because, according to the rule of the House, that body had no *locus standi*. In opposition to the Earl of Crewe's motion for reviewing the decision of the Committee, it was pointed out by Lord Hawkesbury that the County Council were not a water authority. Lord Methuen went a step further, and stated that the Committee felt a bad precedent would be set if they recognized that County Councils "had anything to do with water." We may observe that it would be a happy thing for London if this principle were acted upon in reference to the Council at Spring Gardens. There we have an Authority which seems to think that it has everything to do with water, and is continually being heard upon the subject, both in the Lords and in the Commons, while promoting or opposing Bills relative to the water supply. Another question presented itself in connection with the Rochdale Bill, and one which has lately been urged before the Royal Commission on behalf of the Middlesex County Council. It is what we have called the "intensely local" view, that whatever rain falls upon a county, and whatever stream runs into it or travels under it, belongs inherently to that particular spot of earth. That there is a prior claim in that quarter we readily admit; but that is very different from conceding an absolute right. In last week's debate, the Marquis of Ripon urged that the real point to be considered was whether it was desirable, in the public interest, that County Councils should be heard in regard to proposals to take water largely from their localities for the benefit of other districts or counties. So we find it argued that Rochdale was going to rob the Calder Valley of water required by the millowners and others in Yorkshire. But the House of Lords passed the Rochdale Bill nevertheless. Certainly the people living in the Calder Valley should be secured in regard to their water supply; but if they have none to spare, surely Parliament will be informed of the fact by the proper authorities, without the intervention of the County Council. If the Council were supplying water, that body would have *locus* forthwith. But if the parties who are responsible for the supply do not cry out, why should the County Council proceed to shout? To interfere with matters outside their proper functions seems to be a process possessing peculiar charms for our County Councils in their Progressive character. If anything is left alone, it is

something which, if dealt with, threatens the loss of votes. Water Companies may be attacked, but the costermonger is sacred.

Some striking points relative to the Metropolitan Water Supply were brought to view in the evidence given by Mr. James Bigwood, M.P., before the Royal Commission last week. This gentleman is an Alderman of the Middlesex County Council, and Chairman of the Parliamentary Committee of that body. His statements on the occasion referred to not only gave support to the policy previously expounded by Mr. Littler, but let in some further light on the attitude and aims of the Middlesex authorities. These parties we find described as pleading for non-interference in regard to the water supply of their county. They were satisfied, said Mr. Bigwood, with things as they stood, though they would like to exercise some further measure of control. One objection to the main proposal of the London County Council was that Middlesex had no confidence in that body as a water authority. With respect to a priority of right on the part of Middlesex to the Thames water, Mr. Mellor suggested that every county as one went up the river had a prior right; Lord Llandaff also remarking that if Middlesex maintained its rate of growth, and claimed to be first in taking a supply from the Thames, there would "not be much Thames left for London." Mr. Bigwood's answer was explicit: "It may be so; but that is London's "look-out." Not only does Middlesex lay prior claim to the river, but asserts an absolute right to "all the water which "lies underneath its soil." The New River Company are accused of having sunk wells "surreptitiously" upon their own land; so taking for the benefit of other people that which the Middlesex authorities speak of as their own peculiar property. The Chairman of the Commission asked what would be left for London, with its five million people, if every county claimed the exclusive right to its own water. Mr. Bigwood's solution of the difficulty must have startled the Commission: "Then "London would have to go to Wales." The Chairman shrewdly observed that "the plain English" of the affair was this—that Middlesex wished to throw the cost of fetching water from a distance on London alone. "I "think we do," said the candid Mr. Bigwood. But what has Wales to say in the matter? Has it not also a prior right? Mr. Bigwood explains that Wales would be paid for its water. This is the first we have heard of it; but, if true, it affects the estimate.

Another witness before the Commission was Mr. E. J. Halsey, the Chairman of the Surrey County Council, who stated that Surrey had always opposed any scheme which would place the county under the control of the London County Council. The Surrey authorities had always insisted on having the sources of supply, as well as the means of distribution, in their own hands. Lord Llandaff observed that to this arrangement the London County Council had "very liberally agreed." Still, his Lordship wished to know whether any consideration had been given to the practical difficulties which might occur in separating existing sources of supply between London and Surrey. The witness acknowledged that his Council had not gone minutely, or from an engineering point of view, into the question of severance; but they believed that "between two friendly bodies it was possible." It was agreed that Surrey should take from the Thames as much as their existing supply, *plus* 20 per cent. But even if Parliament would not allow an extra quantity to be taken, the Surrey authorities were advised that they could get sufficient water within their own borders. This was clearly a reference to "underground Surrey," and Lord Llandaff inquired who was to have these new supplies. Mr. Halsey said that Parliament would be asked "to create the Council "a water authority." Lord Llandaff discerned the situation, and described it as showing that Surrey, like Middlesex, hoped never to trouble themselves about a reservoir scheme or a Welsh project. "We do not wish to be saddled with "it," said Mr. Halsey; and he then went on to explain: "Having a water supply of our own, we are content to "supply our own population in our own way, and at our "own cost." London ratepayers may be thankful for the information now given. The London County Council, in contrast with their treatment of the Companies, will very liberally allow the outer authorities to draw from the river, and to tap the underground sources, to any extent they please. If London runs short, she must go to Wales.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-FIFTH ANNUAL GENERAL MEETING,

HELD AT

THE EXHIBITION HALL, BELFAST, JUNE 21, 22, AND 23, 1898.

Mr. JAMES STELFOX, M.Inst.C.E., President.

PAPERS AND DISCUSSIONS.

(*Continued from Vol.* LXXI., *p.* 1551.)

VILLAGE LIGHTING: A COMPARISON.

By R. G. SHADBOLT, of Grantham.

From time to time, the members of this and kindred Institutions have had placed before them statements, more or less complete, showing the relative costs of gas and other illuminants. More especially has this been the case in regard to gas and electricity. Hitherto, however, these comparisons have generally referred either to undertakings such as serve our large towns and cities, or private installations for lighting country mansions, or compact blocks of town or city premises. The question of village lighting, save in exceptional cases, and under abnormal conditions, being generally regarded as outside the pale of practical competition—that is, so far as our friend and rival the electric light was concerned. However correct this idea may have been in the past, it can scarcely be considered to hold good to-day—at any rate, not to the same extent; and it is with a view to placing the present state of affairs upon a comparative basis, that the writer begs to submit for consideration the results of his observations and inquiries.

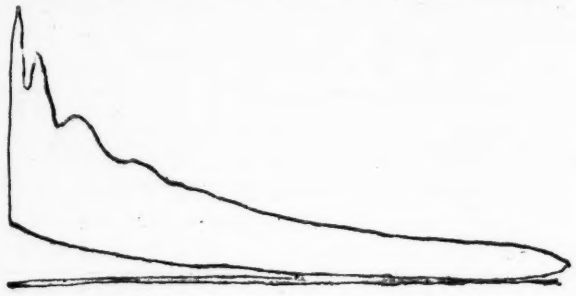
The present is not only an age of ponderous achievement, but also of exacting detail; and to minds trained in the perplexing labyrinths of technical minutiæ, the writer feels that his subject and its bearings will not be deemed too insignificant to receive attention for a short time. And, moreover, considering the notice devoted in the past to the larger undertakings both of gas and electricity, the subject of village lighting may now reasonably claim a hearing.

We have for some time prided ourselves upon the fact that the cheapest method of producing the electric current for lighting purposes in small installations, is by means of the gas-engine; and the large number of such engines employed for this purpose, bears out the correctness of the claim. Economy and extravagance are, however, but comparative terms; and what may be a cheap motor with gas at (say) 2s. 6d. per 1000 cubic feet, may become an expensive source of power when gas is double this price. Generally speaking, it would naturally be expected that the cost of other fuels would increase in a similar ratio to that of gas; and such factors as smallness of demand, heavy railway rates, &c., which conspire as a rule to maintain the price of gas at a high figure, would operate equally in all cases. Yet, provided a source of energy should be available at little if any higher rate than when working alongside the half-crown gas, the case is materially altered, and the relative costs possibly be reversed.

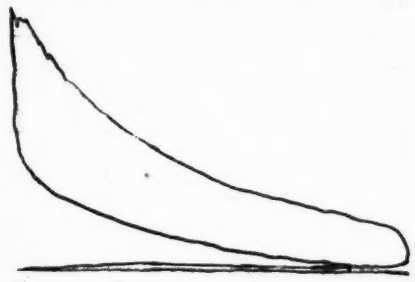
Such, indeed, is actually the case with the natural offshoot of the gas-engine—viz., the oil-engine. It would seem as though Nemesis, in the shape of "Paraffin Oil," is to be eternally on our track; for once more we are confronted with our ancient competitor, whose stronghold has always been the villages and places where circumstances tend to a high-priced gas. The metamorphosis, however, is so complete that, but for its characteristic odour, our old acquaintance would be well-nigh unrecognizable. Nevertheless, there it is again, after playing the part of friend and foe in a diversity of ways, facing us in alliance with the dynamo, intent as ever upon ousting us wherever possible. It is not the writer's intention to wittingly tax your patience by a recital of elementary rules, rudimentary data, or irrelevant description. Yet, in dealing with a subject like the present, something approaching the rehearsal of

established facts may at times be of some assistance; and in such cases I must ask for your kindly tolerance and forbearance.

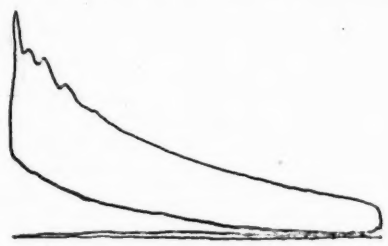
The gas-engine may be said to have long passed the initiatory and probationary stages, and earned its place as it stands to-day among the most economical and serviceable power producers at the disposal of modern science. In fact, for intermittent use, where small power is required, and given a reasonable-priced gas, it stands unequalled. The duty of this type of engine may be commercially expressed as one brake horse power per 20 cubic feet of coal gas consumed per hour, in small engines; and a gas consumption as low as 15 cubic feet per brake horse



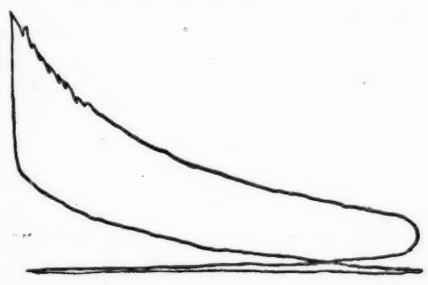
INDICATOR DIAGRAM OF 6-H.P. GAS-ENGINE.



INDICATOR DIAGRAM OF 3½-H.P. OIL-ENGINE.



INDICATOR DIAGRAM OF 8-H.P. OIL-ENGINE.



INDICATOR DIAGRAM OF 25-H.P. OIL-ENGINE.

power per hour in the larger ones. The author has fortunately obtained the results of a set of tests made recently with gas-engines of various sizes, after having been in everyday use for twelve months. These engines supply the motive power at a cycle factory; and the tests were taken independently of the makers by the factory engineer. The results of the tests are given in Table I. (p. 18).

It will be noticed that the engines were not running under the most favourable conditions for securing the irreducible minimum in the matter of fuel consumption. The tests were carried out with engines in working positions after doing considerable duty, with a view to proving the makers' guarantee, and without any doctoring for the occasion. So that claims to run as low as 15 cubic feet of gas per brake horse power under favourable conditions may very well be allowed.

Turning to the oil-engine—which is likely to prove our greatest competitor, both as a motor and a lighting agent, in small communities—we find a machine in all its essentials closely resembling the gas-engine, from the mode of propulsion to the giving-off of power from the driving-wheel. The fundamental difference is that some appliance must be added in the case of the oil-engine for converting the fuel from a liquid to a vaporous state, in order to obtain the necessary explosive mixture. That the work done in the oil-engine cylinder is practically identical with that in the gas-engine, will be at once apparent from the diagrams indicated from gas and oil engines respectively.

The author then, by the aid of some cartoons he exhibited, described the construction and mode of working of the Hornsby-Ackroyd type of oil-engine. He then proceeded: After listening to the advocacy of the use of a heavy unstable vapour in place of one of a more permanent character, one would be quite ready to learn that combustion was less complete. Such, however, is not the case, as the following figures, from a report by Professor William Robinson, of the University College, Nottingham, will show:—

Analyses of Two Samples of Exhaust Gases taken from a 5 Brake Horse Power Hornsby-Akroyd Oil-Engine.

Constituents.	Composition by Volume of Gas. Sample No. 1. Per Cent.	Sample No. 2. Per Cent.	Average. Per Cent.
Carbonic acid	8·60	8·86	8·73
Carbonic oxide	—	—	—
Olefines and benzine	—	—	—
Hydrogen	—	—	—
Oxygen	9·32	8·86	9·09
Nitrogen	82·08	82·28	82·18
	100·00	100·00	100·00

These results indicate that the oil is completely burned in the engine cylinder, with excess of oxygen. The products of combustion formed consist mainly of steam and carbonic acid, diluted with nitrogen and oxygen, no trace of carbonic oxide being detected, so that this exhaust is not in any way objectionable.

The oil consumption in these engines has recently been brought very low. This is the most important factor of all; and below are given the consumption results of a set of tests conducted by independent experts on the makers' works.

Oil Consumption per Brake Horse Power per Hour.

Brake Horse Power of Engine.	At Full Load.	At Two-Thirds Load.
5·0	0·78 pint	0·95 pint.
12·5	0·75 „	0·90 „
25·0	0·70 „	0·84 „
40·0	0·68 „	0·80 „

The oils used in obtaining the above results were both Russian and American, of about ·82 sp. gr., and chosen indiscriminately; the cost being about 4¼d. per gallon delivered at Grantham.

As the tests were carried out on the makers' works, and presumably under favourable conditions, some allowance should be added for working under normal conditions. If the oil consumption of (say) a 25 brake horse power engine be taken to average 0·85 pint per brake horse power per hour, we have a figure which for all practical purposes may be compared with 20 cubic feet of gas per brake horse power per hour from a similar sized gas-engine.

Having dealt with the salient points of the oil-engine, we may now proceed to the question in which this motor may ere long play an important part. Village lighting by gas being a long-established fact, it should be possible with little, if any, trouble to obtain reliable data with reference to it; but woe betide the man who heedlessly rushes into the preparation of village gas analysis. Bitter disappointment is his inevitable portion, as witness the experience of the writer, who, after three months' incessant endeavour to obtain complete and reliable statistics of ten representative English village gas-works with annual makes of from 600,000 to 6,000,000 cubic feet, was reluctantly compelled to rest satisfied with those of eight works. Even then some of the items had to be estimated from the others. Indeed, had it not been for the kind assistance of one gentleman well

TABLE I.—*Gas-Engine Tests at Cycle Factory, Feb. 8, 1898.*

Type and Number of Engine.	Diameter of Cylinder.	Length of Stroke.	Revolutions per Minute.	Circumference of Fly-Wheels.	Load.	B.H.P. Developed.	B.H.P. Ordered.	Number of Shots when Loaded per Minute.	Maximum Number of Shots Possible per Minute.	Rate of Gas Consumed per Hour.	Rate of Gas Consumed per B.H.P. per Hour.	Illuminating Power of Gas.	Pressure of Gas.	Duration of Trial.	Remarks.
	Inches.	Inches.		Feet.	Pounds.					Cubic Feet.	Cubic Feet.	Candles.	Inches.	Minutes.	
Horizontal No. 1	15	22	160	21	638	64 4/5	59	68	80	1,020	15 9/16	18½	1	15	
Horizontal No. 2	15	22	160	21	662½	67⅞	59	67	80	1,176	17 15/67	18½	1	8	This engine stopped after 8 minutes, as the test was too severe, and the load could not be relieved in time.
Horizontal No. 3	15	22	160	20⅝	662½	65⅘	59	68	80	1,200	17 1/7	18½	1	15	Engine was driving two 7-inch heavy belts. B.H.P. is therefore calculated at 68. Junction-ring was cracked, and allowed an escape of gas.
Horizontal No. 4	15	22	160	20¼	638	62 1/3	59	65	80	1,050	16⅘	18½	1	15	Engine was driving two 7-inch heavy belts. B.H.P. is therefore calculated at 65. Trial interrupted by brake-strap breaking.
Horizontal No. 5	9½	16	200	19½	208½	24 7/11	24	81	100	540	21 6/7	18½	1	15	This engine would have stood severer tests easily.
Horizontal No. 6	6½	12	220	12⅝	104½	8⅘	8	99	110	240	28⅘	18½	1	15	One gas-burner on meter in addition to engine.

Note.—The weight of the brake-straps was not included in the calculations.

TABLE II.—*Village Gas-Works Analyses.*

No.	Annual Capacity.	Annual Actual Make.	Maximum Day's Capacity.	Maximum Actual Day's Make.	Length of Mains.	Number of Consumers.	Number of Public Lamps.	Land Occupied.	Cost of Land	Cost of Entire Plant.	Capital Invested.	Cost in Rents per Annum.	Cost in Rates and Taxes per Annum.	Office, Collecting, &c., Expenses per Annum.	Cost of Coal per Annum.	Cost of Purifying per Annum.	Amount of Wages per Annum.	Repairs and Maintenance of Entire Plant per Annum.	Gross Cost per Annum.	Received for Residuals per Annum.	Net Cost Delivered per Annum.
	Cub. Ft.	Cub. Ft.	Cub. Ft.	Cub. Ft.	Miles.			Sq. Yds.	£	£	£	£	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	980,000	600,000	9,000	6,000	2·75	100	25	1,210	100	1,000	1,100	..	6 8 0	11 10 0	52 10 0	2 17 6	60 13 4	20 16 8	154 15 6	15 0 0	139 15 6
2	1,350,000	1,153,100	9,000	7,500	1·50	41	20	2,420	60	900	960	..	5 15 0	10 7 0	115 6 6	3 10 0	50 12 6	38 0 0	223 11 0	11 11 0	212 0 0
3	1,500,000	1,300,400	10,500	7,200	2·50	56	35	4,840	Rented.	1,400	1,400	7	8 19 0	16 2 0	130 0 0	4 0 0	61 2 0	24 0 0	251 3 0	29 18 0	221 5 0
4	1,800,000	1,667,600	16,000	10,200	2·00	70	30	3,630	90	1,500	1,590	..	9 12 0	17 5 0	166 14 0	5 0 0	65 19 6	48 7 4	312 17 10	45 0 0	267 17 10
5	3,000,000	2,400,000	24,000	16,000	2·50	146	43	2,000	Included in plant.	2,000	2,000	..	11 13 8	33 2 4	162 13 9	11 12 7	91 18 6	34 16 9	345 17 7	60 12 4	285 5 3
6	4,750,000	4,000,000	43,000	34,000	3·25	100	48	5,500		3,970	3,970	..	45 4 2	68 1 2	468 18 3	13 6 0	123 10 0	130 1 11	849 1 6	152 6 7	696 14 11
7	5,000,000	4,500,000	45,000	34,500	4·00	125	53	6,000	Rented.	4,200	4,200	50	19 18 7	48 12 2	598 10 0	9 7 0	195 3 8	141 14 2	1,063 5 7	144 15 9	918 9 10
8	6,000,000	5,250,000	45,000	40,500	3·50	150	65	5,000	Included in plant.	5,568	5,568	..	23 12 0	31 3 10	232 0 0	12 7 8	208 2 1	97 4 3	604 9 10	108 5 11	496 3 11
Total . .	24,380,000	20,871,100	201,500	155,900	22·00	788	319	30,600	250	20,538	20,788	57	131 2 5	236 3 6	1,926 12 6	62 0 9	857 1 7	535 1 1	3,805 1 10	567 9 7	3,237 12 3
Average .	**3,047,500**	**2,609,000**	**25,187**	**19,487**	**2·75**	**98**	**40**	**3,825**	..	**2,567**	**2,598½**	**7⅛**	**16 7 9**	**29 10 5**	**240 16 6**	**7 15 1**	**107 2 8**	**66 17 7**	**475 12 6**	**70 18 8**	**404 13 10**

versed in this class of works, the total number would have been five instead of eight.

The idea originally entertained, and adhered to throughout, was to obtain analyses of the working of village gas undertakings in as detailed a form as possible, expressed in such terms as would render their equivalents in electric lighting readily comparable. All the data available having been secured, it was tabulated in numerical order, commencing at the smallest works. Each item was totalled and the average of the eight works taken; this average gas-works to form the basis of comparison. The analyses will be found in Table II. appended. It should be stated that works situate on, or in close proximity to, the coal-fields have been studiously avoided; those places selected being fairly representative of small works administration under average normal conditions.

To render the "average works" analysis more comprehensive, it has, with certain additions, been divided into the three statements given below—No. 1 referring to capacities, consumers, capital, &c.; No. 2, to the entire cost of manufacture, distribution, dividends, &c.; and No. 3 showing the price at which the gas can be sold.

Average Village Gas-Works.

STATEMENT No. 1.

Annual capacity	3,047,500 cub. ft.
„ make	2,609,000 „
Maximum day's capacity	25,187 „
„ „ make	19,487 „
„ hour's output	2,923 „
„ „ consumption	2,843 „
Length of mains	2·75 miles.
Number of consumers	98
„ public lamps	40
Land occupied	3,825 sq. yds.
Total capital invested	£2,598 10 0

STATEMENT No. 2.

Cost of Manufacture, Distribution, &c., per Annum.

Rents	£7 2 6	
Rates and taxes	16 7 9	= £6 8 0 per £1000 invested.
Office, collecting, &c.	29 10 5	= £11 10 0 per £1000.
Coal	240 16 6	
Purifying	7 15 1	
Wages	107 2 8	
Repairs and maintenance throughout	66 17 7	
	£475 12 6	gross cost.
Less residuals and sundries	70 18 8	
	£404 13 10	net cost.
Add 5 per cent. interest on £2598 10s.	129 18 6	
	£534 12 4	gross cost total.

STATEMENT No. 3.

Price of Gas.

	Cubic Feet.
Annual make of gas	2,609,000
Less 16 per cent. lost and used	417,400
	2,191,600 total sold.

£534 12 4 ÷ 2191·6 = 58·54d.

or (say) 4s. 11d. per 1000 cubic feet including meter-rent.

The 16 per cent. deduction for gas lost and used was arrived at by averaging the difference between that made and sold of 48 statutory gas-works as returned to the Board of Trade, with annual makes of from 600,000 to 6,000,000 cubic feet.

So far, no difficulties of any moment have presented themselves; but now we must perforce break controversial ground, and possibly encounter objections at almost every turn. It has in the past been one, if not the principal, feature of comparisons of this kind that either side should object to statements and figures advanced by the other as a matter of course. This antagonism is, however, happily passing away; and so soon as the representatives of both systems of lighting are able to make comparisons unbiassed by party feeling or diversity of interest, will our relative positions be exactly defined, and not before. The present is an attempt to reduce everything connected with the subject to ordinary working averages; taking little account of the duty of lamps, burners, mantles, &c., when in their hey-day, and endeavouring, as far as circumstances permit, to arrive at their average efficiency.

Perhaps the greatest contention is that in connection with the number of electric lamps maintainable per horse power, and the illuminating power of the lamps. It is proposed in this comparison to go upon the basis of the nominal 16-candle power electric lamp; and one of the first determinations necessary is its equivalent in gas lighting. As the electric system under consideration is to be a low-tension one, working at 100 volts, the life of a lamp filament is taken as 1000 hours. From information received, and opinions obtained from various sources, an average light of 14 candles over the 1000 hours would appear to be a generous allowance. In face of the varying number of lamps specified per horse power by different authorities, it seems at first somewhat difficult to say what the actual number should really be; but upon going thoroughly into the question, especially in small installations, and considering the length of cable required in the present case, the writer thinks that no one will demur to an allowance of eight nominal 16-candle power lamps per brake horse power, which will include due provision for consumption at the lighting station. Respecting the gas lighting equivalent of the 16-candle electric lamp, when it is considered that a fairly good regulated No. 5 batswing burner gives, with 17½-candle gas, a light of 14 candles after 2000 hours' use, this burner may well be taken as representative of open-flame lighting. Working from these bases, an endeavour will be made to arrive at the power and cost of an electricity works equal in output to the average gas-works already delineated.

In the general statement of gas-works appended, from which the particulars of the average works were drawn, columns relating to the maximum daily capacity, and maximum actual day's make, will be noticed. These particulars are very essential, more especially the latter, as from it the maximum hour's output may be calculated; and as the electric plant here dealt with does not include accumulators, the maximum hour's load must be provided for in the generating plant itself. The average of a few small gas-works where such particulars have been obtainable, show that the maximum hour's output is about equal to 15 per cent. of the maximum day's make. Hence—

15 per cent. of 19,487 cubic feet	2923 cubic feet.
Less gas lost and used in the hour	80 „ „
Maximum hour's consumption	2843 cubic feet.

Then 2843 cubic feet ÷ 5 = 569 burners, at 5 cubic feet per hour each, equivalent to 569 nominal 16-candle power electric lamps, which, at 8 lamps per brake horse power, require generating plant equal to 71 brake horse power + 5 per cent. margin = 74½ brake horse power, to correspond in output with a gas-works making 2,609,000 cubic feet per annum.

Thus 74½ brake horse power
= 569 maximum lamp-hours.
= 98 consumers and 40 public lamps.
= 5·38 lamps per consumer (average).
= 54,790 brake horse power hours per annum.
= 438,320 nominal 16-candle power lamp-hours per annum.
= 28,061 Board of Trade units per annum, allowing 4 watts per candle nominal.

As varying loads must be dealt with, this 74½ brake horse power would be provided by three oil-engines of 9½, 25, and 40 brake horse power respectively, each with its separate dynamo of suitable size. The arrangement of plant, complete with buildings, storage, and water-tanks, cottage for attendant, &c., occupies 476½ square yards.

The consumption of oil as fuel may be determined from the oil-engine test already given; the average of the whole being 0·8 pint, to which should be added an allowance of 6¼ per cent. for light running and minor defects incidental to constant working. This brings the consumption to 0·85 pint per brake horse power per hour, which, to the writer's mind, is as fair a computation as can well be made. The quality of the oil is similar to that used in carburetting water gas—refined Russian for choice. The cost, taking the average of that in various parts of England, is 4½d. per gallon. Rates, taxes, and office and collecting expenses, are calculated from the gas-works basis of so much per £1000 of capital invested; and the cost of the various parts of the plant, as given in the following statement, are all *bona-fide* current prices obtained from contracting electrical and mechanical engineers.

Village Electricity Works, with Oil-Engines.

Capital Statement.

B.H.P. of oil-engines.	9½			25			40			= Total 74½		
	£	s.	d.	£	s.	d.	£	s.	d.			
Price of engines	160	0	0	320	0	0	480	0	0			
Special steadying fly-wheels	17	0	0	26	0	0	43	0	0			
Circulating water-tank	6	0	0	18	10	0	27	0	0			
" " " connections	3	0	0	10	0	0	15	0	0			
Foundation bolts		17	6	3	0	0	4	0	0			
Exhaust piping	3	5	0	6	10	0	9	10	0			
Continuous oiling gear	7	0	0	10	10	0	12	0	0			
Self-starting gear	..			30	0	0	30	0	0			
	197	2	6	424	10	0	620	10	0			
Less 10 per cent. discount	19	14	3	42	9	0	62	1	0			
	177	8	3	382	1	0	558	9	0	£ 1117	18	3
Dynamos	53	0	0	92	0	0	115	0	0	260	0	0
Belts and fixing	..			..			..			35	0	0
Switchboards complete	..			..			..			150	0	0
2¾ miles of cable and laying	..			..			..			1000	0	0
Meters	..			..			..			500	0	0
Dynamo foundations	..			..			..			12	0	0
	..			..			..			1957	0	0
Vaporizing oil reservoir, one month's supply, with pump, &c., to engine-tanks	..			..			..			15	0	0
20-gallon cylinder oil-tank	..			..			..			1	0	0
20 " bearings "	..			..			..			1	0	0
Sundries and contingencies for plant	..			..			..			50	0	0
										67	0	0
Foundations for engines	..			..			..			24	0	0
Fixing " "	..			..			..			48	0	0
Buildings—Power station	..			..			..			210	0	0
" Cottage	..			..			..			120	0	0
Land = 476½ sq. yds. at 2s. 6d. per yard	..			..			..			59	11	3
										461	11	3

Total Capital Outlay.

Oil-engines	£1117	18	3
Dynamos, switchboard, &c.	1957	0	0
Oil-tanks	67	0	0
Land, buildings, &c.	461	11	3
	£3603	9	6

Village Electricity Works with Oil-Engines.

[Entire Cost of Manufacture and Distribution per Annum.]

Rates and taxes, at £6 8s. per £1000 of Capital	£23	1	3
Office, collecting, &c., at £11 10s. " "	41	8	9
Wages, at £2 5s. per week	117	0	0
Vaporizing oil, 0·85 pint × 54,800 B.H.P. hours = 5822 gallons, at 4½d.	109	3	3
Lubricating oil, 53 gallons, at 1s. 3d.	3	6	3
Cylinder oil, 36 gallons, at 1s. 9d.	3	3	0
Repairs and maintenance of plant, 3 per cent.	93	19	3
" " " buildings, 2 per cent.	7	16	9
Total net cost delivered	£398	18	6
Add dividends, at 5 per cent. on £3603 5s.	180	3	6
Total gross cost delivered	£579	2	0

Selling Price of Electricity.

Annual sales = 28,061 Board of Trade units.

£579 2s. ÷ 28,061 = 4·95d.—say, 5d. per unit, including meter-rents.

In the following summary are compared the two sets of statement referring to gas and electricity respectively:—

	Gas.	Electricity.
Annual sales	2,191,600 cub. ft.	28,061 units.
Total gross cost	£534 12s. 4d.	£579 2s.
Selling price	4s. 11d. per 1000 cub. ft.	5d. per unit.
Equivalent	4·57d. per unit	5s. 3·41d. per 1000 cub. ft.

Little if any comment is necessary. As stated at the outset, electric lighting by means of the oil-engine is now commercially practicable in villages and small places where from any cause the price of gas stands at a high figure; and the cost of production of the two illuminants may be regarded as practically identical.

Before dismissing the subject entirely, a few further comparisons may be drawn from the foregoing figures. If the oil-engine can successfully compete with gas as a lighting agent, through the medium of the dynamo, it must, of course, be a formidable opponent as a motor for ordinary purposes; and from the results of the tests of both gas and oil engines given in the earlier part of the paper, their relative fuel values, pure and simple, may be defined thus—

An oil-engine consumes 0·85 pint of oil per B.H.P.
0·85 pint of oil at 4½d. per gallon = 0·474d. per B.H.P.
A gas engine consumes 20 cubic feet of coal gas per B.H.P.
0·474d. × 50 = 23·7d. per 1000 cubic feet.
Or (say) oil-engine at ½d. per B.H.P. per hour is equivalent to gas at 2s. 1d. per 1000 cubic feet.

The above comparison, of course, only holds good provided all things are equal, and refers to fuel consumptions alone. Such items as difference in first cost, oil storage &c., are not necessary considerations in the present instance. With the numerous systems of gas lighting at disposal, the comparison would be incomplete without some attempt to ascertain their relative worth. In the case of electricity, arc lighting in the present instance is entirely out of the question; and as the incandescent system alone remains, the nominal 16-candle power lamp will be taken as the standard of comparison. Allowing this lamp to yield an average lighting duty of 14 candles over its life of 1000 hours, one unit = 218·63 candle hours. Calculating from this basis, and with a price of 5d. per unit, the relative values of the various well-known systems of gas lighting work out as in the table—"Comparative Gas Lighting Values"—at foot of this page.

From these figures, it would appear that electricity is yet severely handicapped; but this is more apparent than real, for the great majority of gas consumers still cling to the open-flame system of gas lighting, and any method requiring the least attention meets with scant favour. Considering the very small margin between the price of open-flame lighting and electricity, as previously shown, it behoves us, without pessimistic alarm, to set our house in order in the small places and corners of our domains, by applying that same indomitable determination and skill in connection with our villages which has alike saved our reputation as a scientific body, and effected wondrous economies in our town and city undertakings. In what direction improvements and economies may be secured, it is not the object of this communication to indicate. Suffice it if the comparison between the two systems of lighting has been simplified in the least, and those responsible for small works administration assisted thereby.

Addendum.

Since completing the foregoing paper, particulars of an alternative electricity scheme have come to hand which may be regarded as an electrician's minimum, whittled down with little regard for all-round comparison. As it would entail the reconstruction of a great portion of the paper to

Comparative Gas Lighting Values.

System of Gas Lighting.	Candle Power per One Foot per Hour.	Candle Power per Five Feet per Hour.	Unit Equivalent in Cubic Feet.	Unit Equivalents per 1000 Cubic Feet.	Renewals, &c., per 1000 Hours at 5 Cub. Ft. per Hour.	Gross Value of Gas per 1000 Cub. Ft.	Less Renewals per 1000 Cub. Ft.	Net Value of Gas per 1000 Cub. Ft.	Electricity per B. T. Unit.
Open flame	2·8	14·0	78·10	12·80	Nil.	5s. 3½d.	Nil.	5s. 3½d.	5d.
Argand	3·5	17·5	62·48	16·00	1s. 0d.	6 8	2·4d.	6 5½	5
Regenerative	9·0	45·0	24·29	41·16	1 0	17 1½	2·4	16 11	5
Welsbach	14·5	72·5	15·07	66·35	2 6	27 7½	6·0	27 1½	5
Denayrouze	17·0	85·0	12·86	77·76	2 6	32 5	6·0	31 11	5
Bandsept	17·5	87·5	12·49	80·06	2 6	33 4	6·0	32 10	

incorporate this latest addition, the details and notes are given below as received.

DETAILS OF DISTRIBUTING PLANT OF ELECTRICITY WORKS.

Distribution.

Village assumed to have six streets, each half a mile long.
Station about in centre.
Load evenly distributed.
Mean distance of load taken at 440 yards.
Total load, 600 60-watt lamps = 100 lamps per branch.
Distribution—200 volts; each branch requires 30 amperes.
Highest economical density, about 700 amperes per square inch.
Density allowed in this estimate, 430 amperes per square inch—*i.e.*, $\frac{0}{14}$.
Concentric cable.
Greatest loss at distant end, about 19 volts, which in practice would correspond to a variation of less than 5 per cent.

Costs.

3 miles of $\frac{7}{14}$ armoured thread-sheathed concentric cable .	£570
3 miles of trenching, laying, and jointing, at 6d. per yard .	182
100 joint-boxes, at 20s. each	100
100 services and cut-outs, at 20s. each	100
100 electrolytic meters, at £2 each	200
Total	£1102

Note.—We should propose to start the engines from the cells, and so do away with any self-starters; we also propose to use one large water-tank, and connect both engines to it. You will note that our estimate for land and building is much less than yours, although we have allowed for 100 per cent. more floor-space than is required. The plant would have plenty of room in a building 25 feet by 25 feet and 12 feet high. We do not see the necessity of building a workman's cottage under the new plan. We have reduced the man's wages to £2, as we think he could make the 5s. by taking in a premium apprentice. The item of 7½ per cent. for cell depreciation more than covers the wear and tear when taken in conjunction with the fact that the current density on our cables is but 430 amperes per square inch, instead of about 700.

Estimate of Village Lighting by Electricity.

ALTERNATIVE SCHEME.

OUTLAY, &c.

Plant—			
Distribution loss estimated at 10 per cent.:			
Watts to be delivered to mains . .	40,000		
Losses in machines, 10 p. ct. . .	4,000		
,, belt, 5 p. ct.	2,000		
,, regulation, &c., 5 p. ct. .	2,000		
Total watts to be generated. . .	48,000		
B.H.P. required = 64			
Engines, &c.—			
Two, each 32 B.H.P.	£800 0 0		
Two special fly-wheels for above (say) . .	60 0 0		
One special water-tank	30 0 0		
Exhaust piping and water connections . .	30 0 0		
Foundation bolts, £7; oil-tank and pumps, £17	24 0 0		
	£944 0 0		
10 per cent.. . . .	94 0 0		
	£850 0 0		
Foundations, £20; Fixing do., £40 . . .	60 0 0		
		£910	0 0
Dynamos—			
Two 20-kilowatt dynamos with rails, bolts, &c.	£280 0 0		
Foundations and fixing.	10 0 0		
		290	0 0
Switchboard, including regulators, meters, instruments, switches, &c., erected complete		140	0 0
Battery—120 cells, output 90 amperes, at 220 volts 3½ hrs., fitted complete		360	0 0
Distribution, as per particulars enclosed.		1100	0 0
Land—Engine and cell-house 30 ft. × 30 ft. + 100 p. ct. extra room, 200 sq. yds., at 2s. 6d.		25	0 0
Buildings—Power-station and cell-house.		125	0 0
Contingencies, say		70	0 0
Spares—Armatures, £45; belt, £10; engine parts, £25 . .		80	0 0
Total outlay		£3100	0 0

REVENUE, &c.

Rates, &c.—			
Rates and taxes, at £6 8s. per £1000 . . .	£20 0 0		
Office, collecting, &c., at £11 10s	36 0 0		
		£56	0 0
Wages—			
Man £2 weekly (allowing him premium apprentice)		104	0 0
Oil—			
Vaporizing, 5822 galls., at 4½d.	£109 3 3		
Bearings, 52 galls., at 14d.	3 6 3		
Cylinder, 36 galls., at 20d.	3 3 0		
		115	12 6
Repairs—			
3 per cent. on plant—*i.e.*, £910+290+20+120+1100=£2440	£73 10 0		
7½ per cent. on cells—*i.e.*, on £360 . . .	27 0 0		
2 per cent. on building—*i.e.*, on £125 . .	2 10 0		
		103	0 0
Interest—5 per cent. on outlay, £3100 . .	..	155	0 0
Total cost, manufacture and distribution		£533	12 6

Power . . . 64 B.H.P. Engine . .
Battery . . . 30 B.H.P. 3½ hrs.—*i.e.*, Maximum capacity = 900 lamps, 3½ hrs. .
28,061 units per annum, at 4 watts per c.p.
£533÷28,061=4·56d. per unit . . . .

This scheme does not, of course, meet our requirements in every respect; still it is of interest as showing the various ways in which the lighting requirements of villages may be met by our friends the electricians, and is but one more proof of the nearness of their competition in small places.

Discussion.

Dr. STEVENSON MACADAM (Edinburgh) thought he should like to say a word as to the relative values of oil and gas. The subject of the paper was village lighting; and with regard to that, he had undertaken a number of trials—not so much referring to the transformation of oil into electrical power, which had been principally dealt with in the paper, but rather with respect to the amount of illumination which could be obtained from paraffin oil used directly as oil in ordinary lamps. The members would know that a very large number of lighthouses were lit with paraffin oil; and that a very high illuminating power was obtained from it. When contrasting oil with coal gas, the question resolved itself very much into one of relative cost; and, if he might be allowed to say so, he thought many village gas companies were rather greedy with regard to the charges they made. Speaking from his Scotch experience, he thought they generally looked for something like 10 per cent. profit; and he feared the days of 10 per cent. were past, as much for gas as for other modes of investing money. He had made a calculation following the lines of the results Mr. Shadbolt had given, as to the relative amount of light to be obtained from coal gas and from oil, and incorporating the results of his own experiments; and he found that a usual sized cottage lamp, burning ordinary paraffin oil, would give a light of from 5 to 7 candles, while with a larger lamp, such as was commonly used in the rooms of better-class houses, one would get from 18 to 24 candle power. Calculating the amount of light obtained from one of these larger lamps, not specially constructed or designed, there was obtained from a gallon of oil—costing, say, 8d.—about 20 lbs. of sperm light; and bringing this down to a pennyworth of the material, there was obtained 146 candle hours for 1d. The cost of gas, comparatively worked out, came close to the figure Mr. Shadbolt had given for the value of gas and oil in the case of a dynamo. In order to compete with the oil, the gas would have to be supplied at about 20d. per 1000 cubic feet for 14-candle gas. Taking the smaller lamps, such as were used in villages, one did not get so much light per gallon of oil—only equal to about 15 lbs. of sperm (which would work out to 110 candle-hours at 1d.), to compete with which the gas would require to be supplied at 26d. per 1000 cubic feet. This was almost exactly the figure Mr. Shadbolt had given as the price of gas to compete with oil used in an engine with a dynamo. The only other point he wished to mention was the analysis given in Mr. Shadbolt's paper of the exhaust gases, quoted from Professor Robinson, who gave the amount of carbonic acid, and showed that there could be no carbonic oxide if the olefines and benzine were properly burned, nor any free hydrogen. He also gave the proportions of oxygen and nitrogen, but did not give the water vapour, which would have been useful, as without it they could not tell what was the total quantity of exhaust gases. He (Dr. Macadam) must express his admiration for the paper, which gave a thorough account of the use of paraffin oil vapour or gas in comparison with coal gas as a producer of motive power. This was exceedingly interesting to him, because as scientific adviser to the Northern Lighthouses, he many years ago recommended oil to be introduced for the purpose of producing gas to be used as motive power in the engines connected with the lighthouse foghorns. The subject was then in its infancy; but the oil gas proved very effective, and was still employed at Lang Ness Lighthouse, in the Isle of Man, and at the lighthouses on Ailsa Craig.

Mr. ROBERT PORTER (Elland) said, from a literary standpoint, he considered Mr. Shadbolt had been singularly successful in his paper. The subject was one they had heard very little about; but it certainly demanded attention. He thought, however, that in the table giving the relative cost of electricity and gas for lighting a village, Mr. Shadbolt had been rather too generous to electricity. The same amount of care and skill had not been directed to the designing and carrying on of small gas-works as of large ones; and consequently the capital expenditure in the first instance was often excessive. He understood that the figures were based on the actual amounts spent on eight

existing works; but if they were to be put down to-day, as Mr. Shadbolt proposed to put down an electric installation, there would be a considerable saving. The comparison was, therefore, necessarily in favour of electricity. This was the first time they had heard of the important part which the oil-engine might play in the lighting of villages and other places; and there was no doubt, from the figures submitted, that there would be considerable competition in this direction. If he had not known the author, he should, at the first glance, have been inclined to think he had some ulterior motive in portraying this wonderful means of developing power; and he had pointed out to him that it looked something like an advertisement of a particular manufacturer. He was, however, assured that such was not the case. Of course, Mr. Shadbolt could not have prepared the paper as he had done so admirably, without bringing in an engine of some make; and they would readily understand that he had taken the one he considered best. In speaking of the consumption of gas, coal gas was alone referred to; but they heard a great deal lately of what could be done with producer gas.

Mr. Isaac Carr (Widnes) said the paper was characteristic of the author in its completeness and usefulness; and it would be very valuable for reference. He only wanted to make one remark, and that was on the point mentioned by Mr. Porter. He thought it was a mistake to introduce the name of a maker of any apparatus into a paper, when it was possible to avoid doing so; and though he was quite sure Mr. Shadbolt had no thought of advertising the firm referred to, in his opinion it ought to be a general rule for all writers of papers to avoid introducing the name of any trading firm, without special reason. The paper would have been equally interesting if it had referred to oil-engines generally. The excuse might be that this particular type of engine was superior to any other; but names should certainly be avoided if possible. Such a circumstance would not have been passed by the Institution of Civil Engineers; and they could not do better than follow their example.

Mr. William Carr (Stalybridge) did not agree with his brother's remarks. It would be drawing a very hard-and-fast line to say that no one reading a paper should mention the name of the maker of any particular piece of machinery he wished to allude to. If ever a paper was free from the spirit of advertising, this one was. There was a great difference between mentioning a name, and reading a paper which was simply an advertisement—such, for example, as the one which received the third premium the previous day. That was a case in which exception might have been taken. They had heard so much about the gas industry being extinguished, that they had become quite callous about it; and many seemed to imagine that there was no possibility of such a thing happening. But the author had shown how electricity might displace gas, as it could be generated and applied, by the aid of the oil-engine, at a cost equivalent to gas at 2s. 1d. per 1000 cubic feet. This showed that in many villages there was a possibility of the gas company having to cease operations, or be satisfied with less profit. Dr. Macadam suggested that the days of 10 per cent. were over; and it must be admitted that in many places oil-lamps were already a serious competitor with gas-works. He was interested in one or two concerns supplying gas on a small scale; and it made him feel a little uneasy as to their value. At any rate, he hoped they would be able to reduce the price of gas to such a figure as would induce people to use it, instead of going in for the new light. If the gas-works were rebuilt on modern principles, they could compete with electricity, even at the price mentioned; but unfortunately the village gas-works had been built, and could not be reconstructed without throwing away the money already expended. They had to deal with things as they were now, not as they might be. Electricity had all the advantage of modern science; and gas shareholders were often over-weighted with capital spent in times gone by. Under these circumstances, they might have to be content in future with lower dividends. They were much indebted to Dr. Macadam for the additional data he had given.

Mr. T. P. Travers (Cork) said he thought a too favourable account had been given of the oil-engine. In his experience, it caused a great deal of trouble from the choking of the valves; and for this reason, it had been displaced for a gas-engine after only a few months' working. Again, it was maintained that a 16-candle electric light was equal to a 5-foot gas-burner. It might be when first put up, or as tested by a photometer; but he had always noticed that when electricity was introduced into a room, two or three lamps, and sometimes more, were provided to do the work previously done by one gas light. The radiating or diffusive power of the electric lamp was not at all as effective as that of the gas-flame; and the illuminating effect was not to be measured by the candle-power of the lamps installed.

Mr. D. T. Livesey (East Grinstead) said Mr. Shadbolt, in the case of gas-works, had apparently taken his figures from the Board of Trade returns of existing companies, many of whom had probably been established some time, and whose works might not have been erected economically, or might be badly managed. On the other hand, he took an ideal electric light installation. This was hardly a fair comparison; the gas should be taken under the same conditions as electricity. Again, in his table he showed that it was possible to get 1-horse power from $15\frac{9}{13}$ cubic feet of gas; but in his comparison with oil he put in at 20 cubic feet per horse power, thus placing gas at a disadvantage of 20 per cent. at once. It seemed doubtful to his mind whether, in some villages, it would be possible to buy oil at the price named. It certainly would not be in some villages in the South. On the whole, therefore, he thought the author had placed gas at an unfair disadvantage.

Mr. W. W. Hutchinson (Barnsley) said that this was a matter which they all had to deal with at some time or other; and they were much indebted to Mr. Shadbolt for bringing it forward in so able a manner. There was considerable difficulty at present in supplying gas in villages, with a good profit to those who produced it. He thought that Mr. Shadbolt—perhaps from the idea which had been already expressed of not underestimating an enemy—might have gone a little too far in the other direction; and they had probably not expected to hear such a long dissertation on oil-engines. In this description, moreover, he had not alluded to their well known defects. He knew a case in which the mere sight of an oil-engine working to produce electricity was sufficient to induce the observer to at once resolve on a gas-engine, though he had to lay 500 yards of main in order to obtain a gas supply. The offensive smell was an important feature in an oil-engine. The principal difficulty was with regard to the comparatively large capital outlay which was often requisite, in order to give the public in a small village the accommodation they seemed to expect. As to the use of oil in lamps, Dr. Macadam had not alluded to the difficulty of keeping paraffin lighting up to the standard, owing to the very large amount of attention the lamps required to maintain their efficiency. The light obtained on a table, or in a photometer room, was hardly fairly comparable with what was feasible in ordinary village use. He had seen some very poor exhibitions of this kind. With regard to the mention of the name of the maker of the oil-engine by Mr. Shadbolt, he thought too much stress had been laid on it by Mr. Isaac Carr. In many cases, such a thing was quite justifiable; and it would not do to draw the line too tight, otherwise manifest injustice would be done to those inventors who had—frequently at great trouble and expense—perfected various machines and benefited, not only themselves, but the public at large.

Mr. Andrew Dougall, jun. (Tunbridge Wells), said Mr. Shadbolt had compared electricity at 5d. per unit with coal gas as at present supplied to small villages, making the cost about equal. But this comparison was made with a flat-flame burner; and it occurred to him that he had often seen in his own neighbourhood incandescent burners used in villages. If the comparison were made with such gas-burners, the result would, of course, be very different. He took it the author's object was to arouse, in those interested in small gas-works, attention to the fact that they had now a formidable competitor in electricity; but he did not tell them how they were to meet the competition. It was not unusual to find in the same neighbourhood a small works charging a high price and paying no dividend, and another not far off charging a lower price and paying a respectable dividend; and when the matter was looked into, it was generally found to be simply a question of bad or good management. He was referring to very small gas-works, where they could not afford a manager; and on this, he would venture to make a suggestion—viz., that several such small companies should combine to engage the services of an engineer of standing, to whom they could

refer for advice when expending capital or otherwise, and to whom the working results might be submitted from time to time. By such a system of co-operation, they might obtain guidance which they could not afford in any other way.

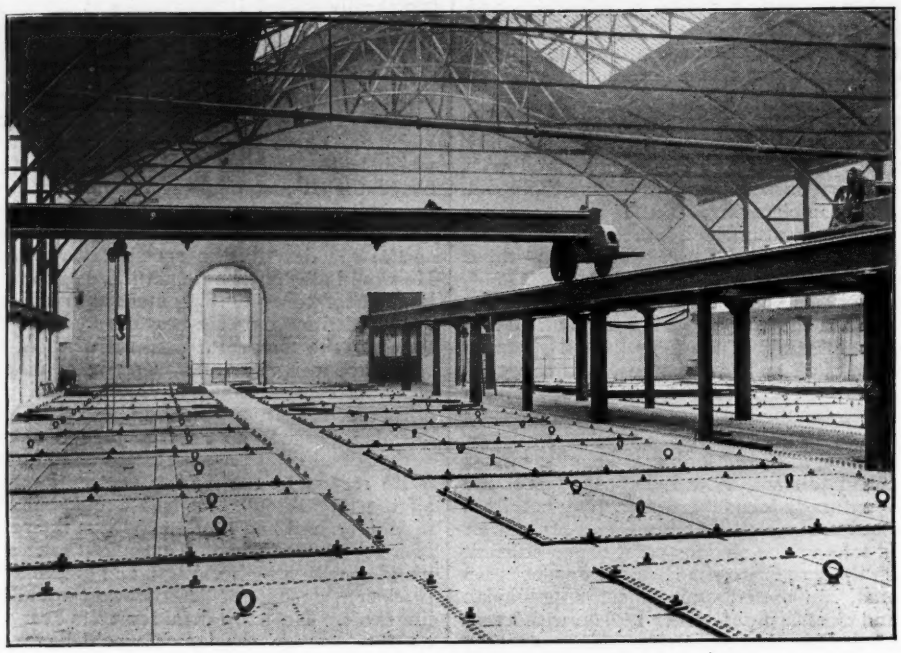
The PRESIDENT said the only thing that occurred to him to refer to was that after all there was not much economy attained by this new mode of lighting as compared with gas, even with ordinary burners; and therefore there did not seem much object in changing. But if they took the table showing what was attained by the use of better burners—which were constantly being improved—there was really no comparison at all.

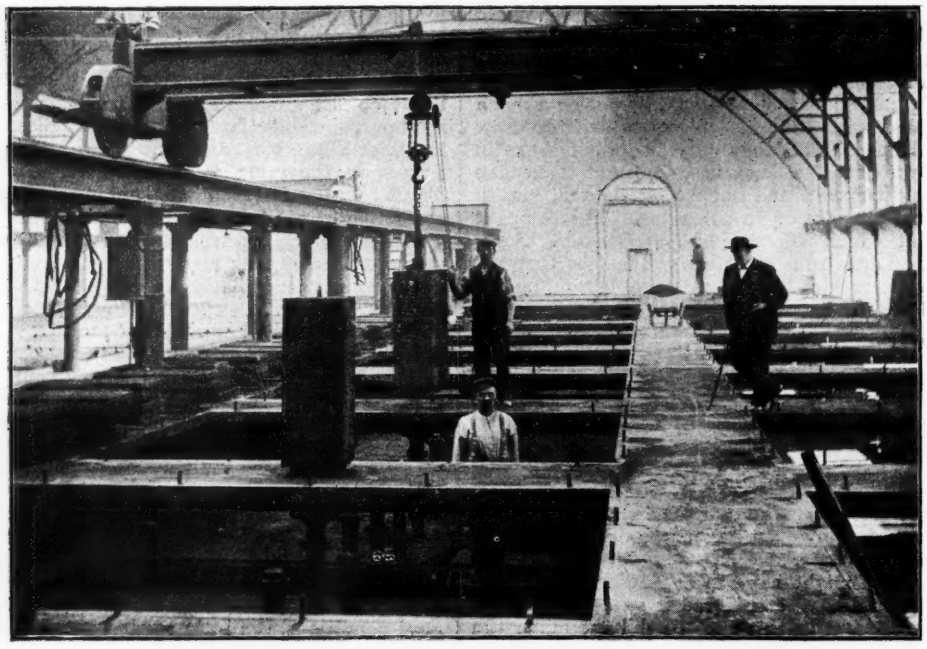
Mr. SHADBOLT said he must thank Dr. Macadam for adding to his figures in the way he had done; and he had no doubt that a careful study of the facts he had given as to the relative value of oil and gas when used direct, would be as useful as his own figures, if not more so. With regard to the analyses of the products of combustion, they were actually made by Professor Frank Clowes. Professor Robinson tested the engines, and took samples of the gases to Nottingham; and this was how it happened that the moisture which naturally condensed out, had not been estimated. He quite expected that his friend Mr. Porter and others would take up the obvious point of the different bases upon which the comparison had been made—between existing gas-works, antiquated and almost antediluvian some of them, and electric light works replete with every modern appliance. But they *must* take things as they were; and these antiquated gas-works existed. The money had been spent upon them; and it would have to be all thrown away before they could start again. Given an ideal case of a village which required lighting, and would take 2 or 3 million cubic feet of gas a year, and new works had to be provided, the gas would be put on a much more favourable basis. But his object had been to draw attention to the fact that they were supplying gas in villages at present at a certain rate, and that the electrician could come in and supply his light at almost the same price, by means of an oil-engine. This brought him to a point which affected him personally. Some of his friends had drawn his attention to the fact that the name of the makers was printed in large letters on his drawings, and had expressed their regret at seeing it. It might be due to his ignorance, or his innocence, but he was the last man in the world to take credit to himself for what other people had done. They had on some former occasions had very able papers, written by someone other than the ostensible author; and papers admirably illustrated, for which credit was given to the author though he had not prepared the drawings. He might be wrong; but he preferred to give honour and credit where it was due. Had he brought before them drawings of an installation of retorts, or of machinery, governors, or any other apparatus which appertained to their own business, and the reading of a paper on which might have meant orders to the firm making it, he should have considered it an advertisement pure and simple. But in this case he did not make the drawings; they were supplied to him by Messrs. Hornsby, who designed and made the engine. He did not, however, think they would get many orders in consequence of the paper. It was said that extremes meet; and on this occasion they had heard Mr. Isaac Carr "going for" him, while his brother took an opposite view. The pendulum swung from one extreme to the other; but he believed they were not far from the happy mean, which would set matters right. They had had *trade* on the brain for some time; and if the name of a manufacturer was mentioned in a paper, it was at once put down as an advertisement. It was possible, however, to go to an extreme; and he was glad the question had been raised, because it gave him an opportunity to protest against it. They would never have anything less approaching an advertisement than what had been referred to that morning. Probably before long the pendulum would swing back in the opposite direction; and ultimately he hoped they would arrive at the happy medium. Mr. Porter asked why he spoke so exclusively of coal gas. But he did so advisedly; and he was rather astonished that such an authority on carburetted water gas should have put the question. He knew, from his own researches, as well as from other sources, that there was a considerable difference in the consumption of a gas-engine, according as it was supplied with pure coal gas or with water gas and coal gas mixed; and on this account he specifically stated it was coal gas he was dealing with. Mr. Travers referred to oil-engines getting their valves blocked; but if he might once more call attention to the engine he had described, he would point out that the vaporizer communicated directly with the cylinder, without any valves or working parts whatever which could get blocked. There were oil-engines giving a very high duty which had this great drawback—where they actually retorted the oil and made it almost into a permanent gas, then admitted it by a valve and ignited it, almost as in a gas-engine. He had seen no other vaporizer so simple as the one described, nor one that worked so efficiently. He would also point out that the engine worked at a very low temperature—nothing more than a black heat, in fact. They relied more on the heat generated by the compression than on the temperature of the walls of the vaporizer to bring about ignition. The study of oil-engines and the effects of compression was very interesting; and if for no other reason than this, he was glad that he went into the question, because he knew a good deal more now about vapours and compression charges than he ever did before. With regard to the power of the lamps and burners, all the way through he had avoided individual cases of high duty, and had tried to arrive at their average efficiency over 1000 hours' work. One might take a 16-candle lamp working with a high voltage, and obtain 25 candles out of it when new; but the deterioration would be rapid, and its life short. He had taken 100 volts over 1000 hours; and on the average the lamps would have an illuminating power at the end of the time of 10 to 12 candles. As to the equivalent in candles of a 5-foot burner, he arrived at the figures from his own experiments; and they worked out to 14 candles with a good batswing regulator burner, after 2000 hours. He thought that it would not look well to be too nice in splitting hairs, so he brought the average light of a 16-candle lamp up to 14 candles, to put it into line with a No. 5 gas-burner. Mr. Livesey alluded to the figures in the table as being referable to the Board of Trade returns; but that was not necessarily so. In two cases they were; but the others were obtained privately. The basis of comparison he had already dealt with. If they were making a comparison between two works to be put down in a new place, the difference would be much in favour of gas. With regard to the price of oil, the makers of these engines had hundreds of them at work in different parts of the country; and for many reasons they preferred to supply the oil themselves. They could set the compression right, and were sure the oil was suitable. Buying in large quantities, they could supply it cheaper than their customers could obtain it themselves; and the price named was the actual average figure paid. Mr. Hutchinson said he had not alluded to the defects of the oil-engine; but this was because they had been almost entirely eliminated. As to the smell, considering the inodorous condition of most gas-works, no doubt the smell of paraffin would be very very obnoxious if one had to work in it constantly; but he did not think in a separate station, working under ordinarily good conditions, the little smell there was would be very objectionable. With regard to Mr. Dougall's remark on the comparison of a flat-flame burner with the electric light, he might have overlooked the table of "Comparative Gas Lighting Values," in which the values of a unit of electricity in comparison with different forms of burner were given. They were not the maximum results, beginning with a new mantle, and so on, but the average of 1000 hours in each particular case. The object of the paper was simply to institute a comparison; and Mr. Dougall's suggestion of how improvements could be made was rather a question for another time. Personally, he agreed with it; and a very similar suggestion was made by Mr. J. T. Lewis, the President of the Midland Association of Gas Managers, in his recent Inaugural Address. The idea was a good one; and if it could be made practicable, no doubt it would place the smaller companies in a much better position.

THE CONSTRUCTION OF, AND MODE OF WORKING, PURIFIERS.

By HENRY GREEN, of Preston.

At the express wish of my friend, our President, I appear before you, though it is with some degree of diffidence I venture to do this, feeling that the experience I have obtained will be common to most gas engineers. But





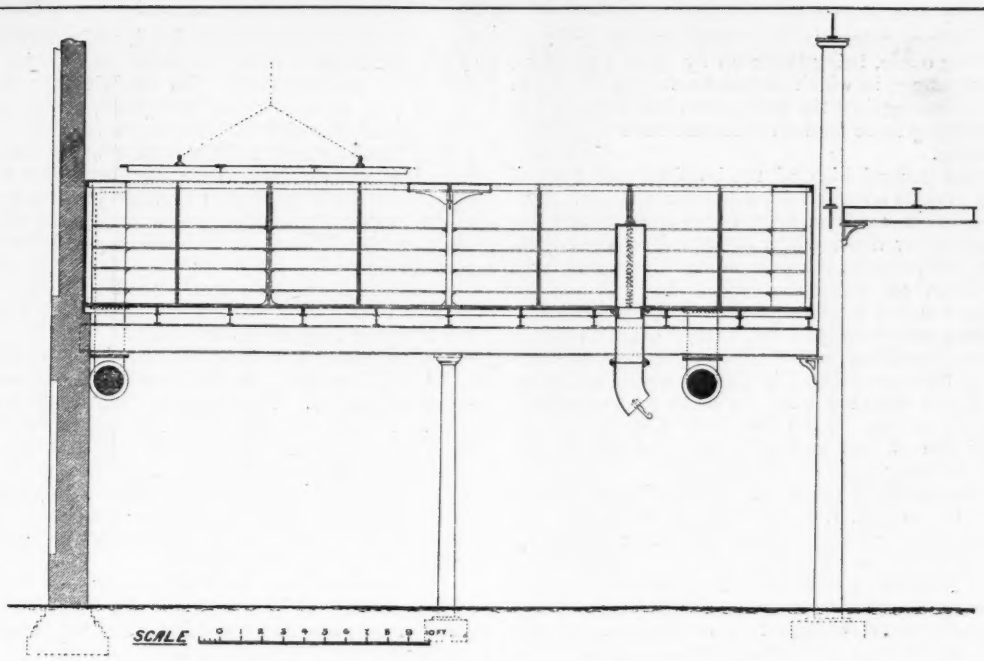
INTERIOR OF PURIFIER-HOUSE AT THE PRESTON GAS-WORKS.

having to some extent departed from the usual lines adopted in the construction of, and mode of working, purifiers, I venture to hope that these departures may prove of interest to, and receive the favourable consideration of, the members. At the outset, I may say that I do not propose to deal with the chemical aspect of gas purification, but shall confine myself to the plans I have adopted as they relate to the construction of purifiers and the mode of working the same.

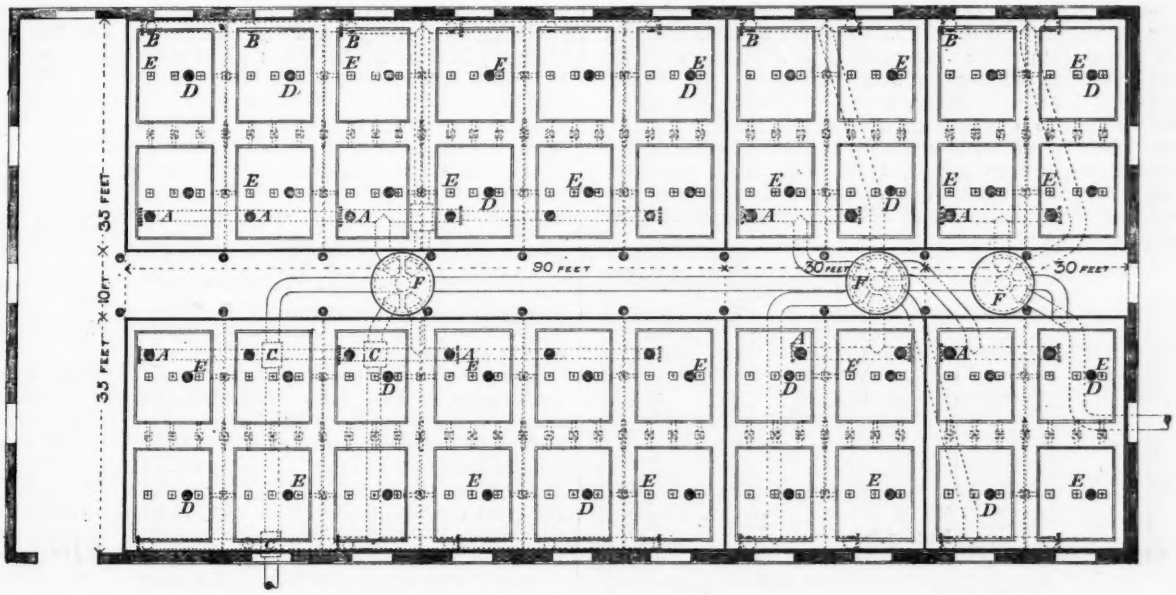
Some years ago, in consequence of the increasing demand for gas, our Walker Street station was pressed to its utmost capacity; thereby causing a serious increase in the back-pressure on the purifiers, and a consequent blowing of the hydraulic lutes. This became so troublesome during the winter months of 1884-5, that it was absolutely necessary some steps should be taken to overcome the difficulty. Three courses suggested themselves: (1) To increase the size of the independent main through which the gas, not only from the Walker Street, but also from two other works, passes to the principal gasholder station, a distance of about a mile and three quarters. (2) To erect exhausters at the gasholder station. (3) To alter the purifiers and the method of working them, so as not only to remove the evils which existed, but to enable the purifiers to meet the strain which the increasing demand for gas would put upon them.

Though the first would have been the most natural solution of the difficulty, the heavy expenditure of capital which would have been entailed in its execution, was a serious objection to its adoption. Regarding the second plan, not only did the same objection apply; but if adopted, a further considerable annual expenditure, arising from the maintenance and working of the plant, would have to be incurred. The third plan, though involved in uncertainty to some extent, suggested itself as presenting the least difficulties; the structural alterations required being simple, and the outlay inconsiderable.

It was therefore decided to adopt this course; and so it became necessary to alter the construction of the purifiers, by which I largely increased the area and reduced the number and thickness of the layers of oxide of iron through which the gas had to pass. The change, when effected, practically increased the area, by 100 per cent., and reduced by 30 per cent. the thickness of the oxide;



CROSS SECTION OF PURIFIER AT THE PRESTON GAS-WORKS.



A. Inlet Pipes. B. Outlet Pipes. C. Crossing Boxes. D. Emptying Shoots. E. Standards. F. Centre Valves.

PLAN OF PURIFYING-HOUSE AT THE PRESTON GAS-WORKS.

the first being increased from 432 feet to 864 feet, and the latter reduced from 90 inches in six layers to 60 inches in four layers of 15 inches each. Prior to the change, the purifiers at our Walker Street station were ten in number, each 18 feet by 12 feet. Eight of these were worked in two sets of four purifiers in each, and were loaded with Irish bog ore; the remaining two being charged with lime. The alteration effected was to change the construction of the centre-valves, and convert the eight oxide purifiers into two large ones. In carrying out the change, the boxes themselves were not interfered with; but the inlet-pipes of four of the purifiers were connected together, as also the four outlet-pipes—thereby converting four purifiers into practically one box 48 feet long by 18 feet wide. I also erected a catch purifier, having four small dry sealed lids, and the top intersected with gangways.

After the purifiers were put into action, the result of the change so fully answered expectations, that it was determined when getting out plans for the reconstruction of our Moor Lane station to adopt the same construction of, and mode of working, the purifiers. This was carried into effect by the erection of six purifiers—two for oxide, each 90 feet long by 35 feet wide by 5 ft. 3 in. deep; the remaining four (three to be used for lime and one for catch) being each 35 feet by 30 feet by 5 ft. 3 in. It will naturally occur to you that, in erecting purifiers of a size such as the larger ones, several points would have to be carefully considered; some of these being: (1) In case hydraulic seals were used, the covers, from their size and weight, and the appliances needed for lifting them, would prove to be both costly and unwieldy. (2) In the absence of mechanical means, the loading of the purifiers would be inconvenient. (3) Measures would have to be adopted for giving stability to the tops and sides; for it must be borne in mind that in a purifier of the size named, with a back-pressure often existing of 24 to 30 inches, there would be a strain on the top of 150 to 200 tons, and 70 to 85 tons on the four sides. By the adoption of dry sealed covers, and dividing the tops of the purifiers into a series of gangways, I was able to deal successfully with these three points.

Description of the Purifiers.

As shown in the accompanying engravings, the building where the purifiers are erected is 166 feet long by 80 feet

wide; the whole area, except 16 feet at one end, which is used for storing oxide, being taken up by the six purifiers, and a centre-passage in which the centre-valves are fixed. The purifiers abut against the walls of the building on three sides; there being three on each side, and a centre-passage 10 feet in width.

A very good general idea of the building and tops of the purifiers may be obtained from the illustrations. The lower floor of the house is on a level with the surrounding yard, and the upper floor, which is formed by the tops of the purifiers and passage, is about 20 feet above this level. The lower floor, on which the foul oxide is discharged through shoots in the bottoms of the purifiers, is mainly used for storing and revivifying the oxide. On each side of the centre-passage rising from this floor, there are columns 15 feet apart for supporting the girders which carry the purifiers. These columns pass the sides of, and extend 7 feet above the tops of, the purifiers. On the tops of the columns, the girders and rails are fixed for the travellers used in lifting and moving the lids.

In the centre-passage, there are three hydraulic centre-valves—the first, or No. 1, controlling the two large purifiers; No. 2 controlling the three lime purifiers; and No. 3, the catch and bye-pass. The main pipes to and from the purifiers range from 24 inches to 12 inches in diameter; these gradually diminishing from 24 inches as the various branches are taken off the main. To obtain more head-room on the lower floor, the crossing-box invented by our able President was adopted. Details showing the construction of this will be found in the "Transactions" of the Institution of Gas Engineers for 1895.

The inlet-pipes, after leaving the centre-valves, run lengthwise underneath the purifiers. At every 15 feet, branches are taken from these and coupled to the bottoms of the purifiers; the outlet-pipes being arranged in a similar manner. I may, however, here say that I lean to the belief that the distribution of the gas in the purifiers would be as uniform if one 24-inch pipe were coupled to the bottom of each purifier instead of these numerous branches; thereby avoiding considerable expense. The estimate of weight which I shall shortly refer to, is based on this assumption.

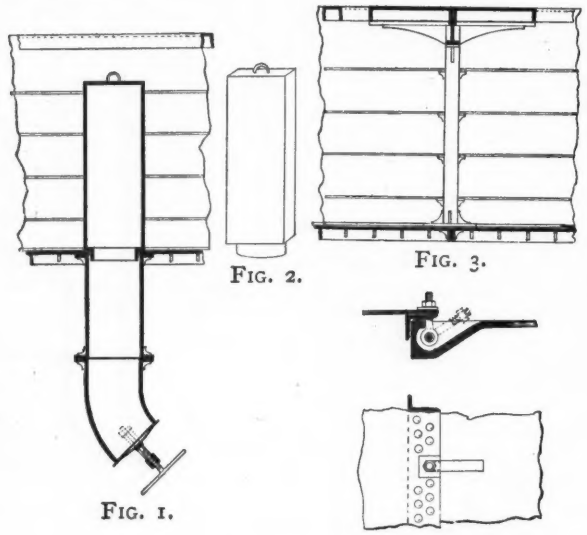


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

The purifiers or boxes are of cast iron; the metal being ¾ inch thick. Three of these are on each side of the house—*i.e.*, one 90 feet by 35 feet, and two 35 feet by 30 feet. The three are built as one large cistern, 150 feet long by 35 feet wide; the purifiers being divided from each other by cast-iron partitions, the plates of which are bolted between the flanges of the bottom, sides, and top gangway plates. At convenient distances, there are a number of pipes or shoots (fig. 1) bolted to the bottoms of the purifiers. Through these shoots the foul material is discharged. Their lower ends, when the purifier is at work, are closed by means of lids, on a principle very similar to an ordinary luted retort-lid.

Others who discharge the foul oxide through the bottom of the purifier have no doubt, with me, noticed the trouble and serious distress experienced at times by the men from the gas which becomes liberated, when, to obtain access to the discharge shoots, the oxide and grates are being disturbed and removed. To obviate this, hollow iron blocks (fig. 2), each 17 inches square, are placed over the openings in the shoots. The tops of these (which are 4 feet long) extend a little higher than the top grate. When a purifier has to be emptied, these blocks are lifted from their positions; thereby leaving a clear open space over each shoot, through which the oxide may be discharged. When these, before a purifier is loaded, are placed in position, the joints between the blocks and the tops of the shoots are made good by means of mortar luting; thus giving extra security against any escape of gas from the mouths of the shoots.

It will be seen from the plan and photographic reproductions, that the tops of the purifiers consist of a series of gangways and covers. The gangways round the sides are 2 feet wide. The one running full length and up the centre of the three purifiers is 4 feet wide, as also are the cross-gangways, of which there is one at a distance of every 15 feet. The spaces between the gangways are the openings into the purifiers; these being 13 ft. 6 in. by 11 feet each. There are twelve of these openings in each of the larger, and four in each of the smaller purifiers.

The importance of staying purifiers of this size has already been alluded to; and at the time of their erection some of my friends prophesied disaster. I am, however, pleased to say the prophecy is still unfulfilled; and I may further state that I have never seen purifiers of even a small size more rigid—no indication of springing either of the tops or sides under our heaviest back-pressure having been detected. To obtain for the sides this stability, stiffening or gusset-plates 2 feet wide are fixed at distances of from 7 ft. 6 in. to 8 ft. 9 in.; these extending from the bottom to the top plates, between the flanges of which, as well as to those of the side plates, they are securely bolted. The stability of the top of the purifier is insured by means of the standards or pillars which carry the bearers for the grates; these standards under the gangways (fig. 3) being bolted to the bottom plates of the purifiers, and to those forming the gangways. These standards under the longitudinal gangway are 3 ft. 9 in. apart, and 8 ft. 9 in. under the cross-gangways. Where the standards, as under the cross-gangways, are 8 ft. 9 in. apart, the gangway between the standards is supported by a small cast-iron girder 6 inches deep (fig. 3). This extends between, and is bolted to, the upper part of the standards.

The covers or lids I am about to describe are dry-sealed, each 14 feet by 11 ft. 6 in. These lids, though known for many years, have been little used. In the adoption of covers such as these, it may be assumed that they would require securing at more points than is the case with an ordinary hydraulic cover. This being so, to avoid some of the extra trouble arising from having to remove and replace the nuts of the holding-down bolts whenever the covers had to be raised or lowered, a number of pockets (fig. 4) were cast in the gangway-plates round the openings into the purifiers in which the holding-down bolts were hinged. By this plan it was anticipated that, after the nuts were loosened, the bolts would easily be knocked back out of the slots in the covers, so as to clear them when being raised or lowered. As others may be inclined to adopt this or some similar plan, it is desirable to point out that in practice it has been found that these pockets get choked with oxide or lime; the bolts becoming rigid, and the device useless.

Each lid consists of three wrought-iron plates 5-16ths inch thick, and butt jointed. The joint is overlapped by a butt strap 7½ inches wide, double riveted on each side. Underneath each joint there is a tee-iron bar, 4 inches by 3½ inches by ⅜ inch; this being secured to the plates and butt straps by means of two rows of rivets, one on each side of the butt joint. Extending round, and on the underside of, the outer edge of the cover, there is secured an angle-iron ring 4 inches by 3½ inches by ⅜ inch (fig. 4); the rivet heads on the face of the angle-iron being countersunk so as to obtain a flat surface for the rubber or gasket which forms the joint. As before stated, there are twelve of these lids in each of the large purifiers, and four in each of the smaller ones. Each lid weighs 26½ cwt. The holding-down bolts, of which there are 18 to each cover, are from 3 feet to 3 ft. 6 in. apart. When lifting a lid, the man stands upon it and raises it by means of a two-ton differential pulley-block. Two lids are removed on the traveller at one time.

The medium used for making the cover gas-tight is soft vulcanized rubber, in strips of about 1¼ inches wide and ⅜ or ½ inch thick; but loose spun gasket has also been used with a fair amount of success. It is, however, very necessary that, whatever medium is employed, means should be taken to make it adhere firmly to the cover; and for this purpose, for the rubber strips ordinary rubber solution has been used, and for gasket white lead. It is also essential that the sticking of the medium to the top of the purifier should be prevented. A paste composed of black-lead and tallow, applied to the metal surface, has answered the purpose. Though the system of bolting down these covers is not (neither was it expected to be) quite as expeditious as in the case of hydraulic lids, this disadvantage is largely counter-balanced by the advantage arising from the facility with which the covers can be handled in consequence of their reduced size and weight.

In addition to the advantages already alluded to, economies in the cost of purifiers constructed on this principle and the reduced space occupied by them, are further great gains. Respecting space, as an illustration, take eight large purifiers, each 37 ft. 6 in. by 35 feet, and having the same purifying area as the six now described. These eight, with the usual 6 feet surrounding passages, would occupy 180 feet by 92 feet, or 16,560 square feet, as against 150 feet by 80 feet, or 12,000 square feet.

In considering the question of cost, as the price per ton may vary according to varying circumstances, it may be better to take as a basis the weight. But in doing this, it must not be forgotten that these purifiers, being of a simpler construction and having much less expensive covers, can be erected at considerably less cost per ton than can purifiers on the ordinary system. I am indebted to Mr. Wright, of Messrs. Ashmore, Benson, Pease, and Co., for some useful information as to the weight of the several parts of various sizes of purifiers, which that firm have either erected or estimated for, and which enables me to give the following details :—

Size of Purifiers.	20 ft. by 20 ft. by 5 ft.	30 ft. by 30 ft. by 5 ft.	70 ft. by 30 ft. by 5 ft.	50 ft. by 30 ft. by 6 ft.	40 ft. by 30 ft. by 6½ ft.	Average	Three Purifiers at Preston. 150 ft. by 35 ft. by 5¼ ft.
Weight of Purifiers.* Pipes, exclusive of centre-valve . . .	7·14	5·0	Not given.	6·41	2·54	5·27	1·72
Boxes . . .	23·00	18·5	17·5	16·20	15·50	18·10	15·80
Covers . . .	4·20	4·5	4·1	7·20	4·20	4·80	2·18
Total . .	34·34	28·0	..	29·81	22·24	28·17	19·70

* In lbs. per cubic foot of area.

A total saving is therefore effected on the weight, as compared with the average, of 30 per cent.; 67 per cent. on the pipes; 13 per cent. on the boxes; and 54 per cent. on the covers. But in addition to the saving effected in these parts, there are further economies arising from the reduced number and strength of the girders, &c., carrying the purifiers, and the cheaper and simpler apparatus required for lifting and removing a series of small covers, each weighing 26½ cwt., as against one large cover weighing from 20 to 30 tons.

In bringing this subject under your notice, it was my intention originally to deal with it from a structural point of view only. But you will probably not demur to my giving you a short account of the mode of working the two oxide purifiers, and the result so far as it affects back-pressure. Already I have described the objects I had in view when a change was made in the form of the purifiers at our Walker Street station; these being to increase the area of the space, and reduce the thickness of the purifying material through which the gas had to pass, so as thereby to reduce the back-pressure.

From the foregoing, it will be seen that the system of purification adopted has been the substitution of two large purifiers for four having the same total area, but worked on the usual system of one at rest and three at work; these two being controlled by a hydraulic centre-valve so arranged that one purifier at a time could be worked or the gas might pass alternately through first one and then the other. Besides these, there are three smaller purifiers for lime, and one catch purifier; but I propose mainly to deal with the two large oxide purifiers. At the outset of this section of my paper, I may say that no air or oxygen is passed with the gas; and as our hydraulic main is dry, the exhausters work at zero.

In each of the two purifiers, there are two 15-inch layers of oxide. Gas, therefore, when working through both purifiers, has to pass four layers; these being equal to 5 feet thickness of oxide. Reasonable care, I need scarcely say, requires to be exercised in loading; but I find that, given this care, the oxide when discharged is very evenly fouled. Both purifiers are kept at work until the gas shows a foul test on the top of the third layer of oxide; thus relying on one layer of clean oxide during the time the foul purifier is being discharged and reloaded. When first deciding on this system, a doubt existed in my mind as to whether it would be safe to rely on one layer of oxide; but consideration convinced me (and results have fully justified this opinion) that it would be safer to pass gas slowly—*i.e.*, at half the speed through 15 inches thick of oxide, with a superficial area of 3150 feet, than more rapidly through 30 inches with an area of 1575 feet.

There are several reasons why I cannot give such complete details as to the working of these purifiers as I should desire; these being: (1) When I erected these purifiers, I never anticipated that I should be so injudicious as to consent to read a paper on either this or any other subject; hence such observations and records were not kept as otherwise would have been. (2) At our Moor Lane station both coal and carburetted water gas are passed through the same purifiers. (3) The same oxide is used for absorbing the sulphuretted hydrogen contained in the waste gases from the manufacture of sulphate of ammonia; and the importance of this point may be gauged from the fact that this plant deals with the whole of the crude ammoniacal liquor produced from a make of 400 million cubic feet of gas per annum. This latter point seriously affected the working life of the oxide; considerably reducing its usefulness for, and making the following details somewhat unreliable respecting, the coal-gas purification.

These purifiers were first loaded from a cargo of 500 to 550 tons of Irish bog ore. I estimated that 300 to 350 tons would be loaded into the two large boxes; the balance—about 200 tons—being either at rest or in use in the sulphate of ammonia purifiers. During the time the oxide was in use, the purifiers were changed 22 times, and it purified 552 million cubic feet of coal gas—an average of 25 million for each change of boxes—and when disposed of, the spent oxide, weighing about 800 tons, contained 55 per cent. of sulphur. From this, taking into consideration the increase in bulk which during use takes place in the oxide, it may be assumed that the same oxide was in use in the purifiers about five times.

The oxide at present in use—a cargo of about 600 tons—has purified 240 million cubic feet of carburetted water gas, and 450 millions of coal gas. It now contains 40 to 45 per cent. of sulphur. The boxes have been changed sixteen times; and I estimate the same oxide has passed through the purifiers about four times. During the past winter, from Nov. 10, 1897, to Feb. 28, 1898, the purifiers were changed three times, and purified 150 million cubic feet; 59 millions being carburetted water gas, and 91 millions coal gas—thus giving an average of 50 millions per box.

The figures in the table on next page record the result of three to four winter months' working, and give a clear idea as to the back-pressure on each of the oxide and lime purifiers at various intermediate dates. During this period, the oxide in use would contain from 30 to 45 per cent. of sulphur.

It will be seen from these figures that, during the earlier period, after a purifier has been changed, there is comparatively little back-pressure on either of the oxide purifiers, even when the oxide is largely charged with sulphur, and the maximum daily make of gas is passing, this pressure usually ranging from 5-10ths to 10-10ths of an inch. But a very rapid and considerable change occurs when the gas, after passing the third layer—or through 3 ft. 9 in. thick of oxide—shows a foul test; this increase in from 24 to 48 hours ranging on the first purifier from 1 to 11 or 12 inches, thereby at times compelling us to change the oxide purifiers earlier than we otherwise should have done. I may mention that this increased back-pressure does not

Working of Purifiers from Nov. 10, 1897, to Feb. 28, 1898.

Date.	Number of Days after Change of Purifiers.	Day on which Gas showed a Foul Test on the Third Oxide Layer.	Average Hourly Make of Gas in Thousands of Cubic Feet.			Millions of Cubic Feet of Gas Purified.	Back-Pressure in Tenths of an Inch.			
							Oxide Purifier.		Lime Purifier.	
			Coal Gas.	Carb. Water Gas.	Total.		First.	Second.	First.	Second.
1897. Nov. 10 to Dec. 26	20	44th	35	30	65	Coal gas . . . 38 Carb. water gas . 27 Total . . 65	10	6	6	16
	35		37	31	68		13	8	18	28
	29		37	23	60		14	8	23	8
	43		37	29	66		17	8	8	9
	44		36	29	65		23	7	8	11
	45		37	29	66		78	7	7	8
	46		37	..	37		76	4	7	10
	47		36	..	36		112	3	6	11
Dec. 26, 1897, to Jan. 19, 1898	1	24th	36	..	36	Coal gas . . . 22 Carb. water gas . 11 Total . . 33	3	..	6	11
	5		37	30	67		8	..	23	14
	9		36	23	59		8	..	22	15
	14		37	7	44		10	4	26	18
	19		34	34	68		11	5	28	24
	23		35	30	65		14	5	24	14
	24		36	32	68		22	5	24	15
	25		37	32	69		123	5	23	14
1898. Jan. 19 to Feb. 28	1	37th	37	32	69	Coal gas . . . 31 Carb. water gas . 21 52	5	..	14	20
	6		34	30	64		6	..	22	23
	11		35	24	59		6	..	20	11
	13		35	31	66		6	4	11	25
	18		34	14	48		8	4	14	20
	23		34	29	63		9	4	20	22
	30		29	22	51		8	3	18	13
	36		26	29	55		9	4	10	13
	37		28	16	44		54	2	4	5
	39		28	25	53		59	4	10	15
	40		29	15	44		70	2	6	4
	41		29	28	57		80	2	5	3
	41						101	4	15	10

arise in any respect from the hardening or caking of the oxide, as when the purifier is opened the oxide is found to be loose and fairly free.

I cannot fully explain the cause of the sudden rise of pressure. But I conclude that so long as there are less than three layers, or 3 ft. 9 in. thick, of foul oxide, through which the gas has to pass, back-pressure in our case does not exist to any serious extent; but immediately these three layers become foul, it increases so rapidly, and to such an extent, as to become troublesome. If this has been our experience, notwithstanding our large purifiers and the reduced number of layers and thickness of oxide it may be reasonably assumed that with more purifiers of a less size and having six layers—or, say, 7 ft. 6 in. thick of oxide, 5 feet of which being foul—back-pressure will not only be great, but continuous.

In submitting this paper for consideration, I do not wish to press my views unduly upon the notice of the members; but, in conclusion, I may say that the advantages I have derived from the changes made are in my opinion so beneficial that I should not think of reverting to the old system, either of construction or mode of working my purifiers.

Discussion.

Mr. John West (Manchester) said they must all be thankful to the President for inducing Mr. Green to read his paper, which would be very useful to the members. He had had an opportunity of seeing the purifying-house in operation, in company with a large number of Lancashire members; and they were much impressed by what Mr. Green had to show them. He himself was impressed with the ease and facility with which the covers were removed. At first, he had a little prejudice against them; but this was removed after the explanations they had received, and when they saw the way they were manipulated. Mr. Green proved beyond doubt that his plan was successful; and therefore practical men might take his views as being of considerable advantage in his special case, and perhaps in others. One of the great advantages of large purifiers was the slow velocity of the passage of the gas, which no doubt accounted for the purifying material having to be changed so seldom. It was stated that Mr. Green only moved it five times in order to get 50 per cent. of sulphur taken up; and he (the speaker) did not think many could say so much as that. Besides the saving in first cost, Mr. Green must also save in labour. He thought the purifiers that were changed when the Lancashire contingent visited the works, had not been changed for some months. A special arrangement had to be made to show it even then; and they were surprised at the ease with which the light covers were lifted. There was one point, however, which Mr. Green took credit for, which he did not think he would give him, because they could do the same with lutes. It was unnecessary to have a cross space between lines of purifiers. It was possible to take up all the area if two rows were put down the house, with a passage through the centre. There might be a division-plate with two lutes upon it. Personally he thanked Mr. Green for the information he had furnished, and should like to know if he could give any figures as to the relative difference in cost of plant and working.

Mr. Green said the weights were given in the table. They were based on the figures he had had with respect to the weights of the five sets.

Mr. S. Y. Shoubridge (Lower Sydenham) said there was so little variety in the construction of purifiers—which differed now, in the great majority of cases, only in their size from what they were almost a hundred years ago—that it was refreshing to come across the decided originality Mr. Green had shown. He was one of the few—if, in fact, there were any others—who purified the gas from the sulphate plant and the water-gas plant, as well as the ordinary coal gas in the same set of purifiers.

Mr. Green remarked that his paper did not quite express what he meant to convey, which was that he purified the gas from the water-gas plant and the coal-gas plant in the same set of purifiers; but not that from the sulphate plant, which was dealt with separately.

Mr. Shoubridge said he was struck by the large area of purifiers Mr. Green had in proportion to the make of gas; and he should be glad to know how the cost per 1000 cubic feet for purification compared with the purifiers Mr. Green had before, and also how long the india-rubber luting lasted. The adoption of this form of lid seemed a great improvement on the old system of water luting. If the material used for the joint was perfectly tight, and lasted a reasonable time, it would be a great advantage, and would very considerably reduce the cost of construction, and the difficulty of working.

Mr. Isaac Carr (Widnes) asked if Mr. Green had any particular reason for not employing the air process. The figures he had given of the work done by these purifiers, without the admission of air, were sufficiently wonderful; and the results were doubtless due to the slow velocity at which the gas passed through the purifying machinery. But it occurred to him that, if the result with oxide alone could be so much above that obtained in ordinary purifiers, a proportionate increase might be obtained by the admission of air. He might then be able to purify such an abnormal amount of gas that he might have to change only in some two or three years, judging by the proportionate length of life which was gained in ordinary purifiers by the adoption

of the air process. They knew now that air could be admitted without any sacrifice in illuminating power, or any other attendant disadvantage; and he was rather at a loss to discover why Mr. Green had not adopted it.

Mr. R. G. SHADBOLT (Grantham) was struck, on reading the paper, with the part which dealt with the sudden rise of back-pressure when the third layer became foul. They were all more or less acquainted with the important effect in purification of lime contact, and most of them had a very fair idea as to the minimum time with which they could purify; but very few had any experience which would lead them to place the maximum limit. Mr. Green had evidently reached this limit. In purifying, especially with oxide of iron, there preceded the gas as the oxide became foul a kind of moist film, composed principally of water vapour; but added to this was a little oily vapour, according to the condition and capacity of the various other apparatus through which the gas travelled. By maintaining a certain velocity, this might be driven forward through five or six tiers of materials; but one could imagine that if the velocity were reduced below a certain limit, it had time to accumulate, and so formed a kind of veil, until it reached a certain stage, when it became of such a thickness, and offered such resistance, as to cause the back-pressure which had puzzled Mr. Green.

Mr. S. W. DURKIN (Southampton) said he could not see why the form of cover which Mr. Green had adopted at Preston should not be more generally introduced. They all knew that the covers of purifiers, especially when large, were a troublesome part of the plant to keep in order; and the wear and tear was very great. When one came to a rising back-pressure, it meant an increasing depth of the lutes, so as to restrain any blowing tendency. In his case, with an increasing production of gas, this had been getting greater; so that every time new purifiers had been put down deeper lutes had to be provided, in order to maintain a proper seal. He hoped the ventilation of this subject might lead engineers to a fuller demonstration of the principle of the dry-luted cover. He presumed Mr. Green was not troubled with the sulphur clauses; for he understood that he used oxide in the first instance, and some lime to arrest the carbonic acid. Some of them in the South of England were being troubled with the sulphur clauses; and consequently the lime came into operation first in nearly all the works there. At Southampton, they had not been under the sulphur clauses by any Act of Parliament, but would be in the course of a month or two. For some years past, however, they had been working as if they were. He presumed this method of putting so many boxes together would require some modification, if the lime process was more to the front than the simple extracting of sulphuretted hydrogen from the gas with oxide.

Mr. W. H RDIE, jun. (North Shields), said he noticed Mr. Green increased his purifying area by about 100 per cent. They all knew that increasing the area of purifiers ought to decrease to a large extent the cost. Therefore, it would be interesting if he could give the cost of purification before and after this enormous increase. It was interesting to note the saving in space, and also in initial cost; but it seemed to him that there would be a good deal of wear and tear on the india-rubber joints and gasket. He would like to know if Mr. Green could give the cost that his purification worked out at, and also of the repairs and maintenance of the luting arrangement.

Mr. THOMAS CANNING (Newport) said they were much indebted to Mr. Green, even if he had done nothing more than bring before them the improvement he had made in purifiers. He agreed with Mr. West's observation, that it was quite possible to ameliorate the condition of affairs in respect of the cross-gangway system by the old method of luting, as he had a set of purifiers in action at one of his stations put up in 1879. The whole set was in one tank; the lutes being simply divided by cross cast-iron partitions. When putting them up, he had no heroic intention of introducing any novelty. He was simply in a corner for want of space, and had to adopt this plan or none. It was suggested at the time by a good many, that some accidents might occur if there happened to be a leakage between a box in action and one out of action, and that if the seals became equalized one of the boxes might blow. No such accident had occurred; and all the purifiers were worked without any cross-floor gangways. It would be a great advantage, too, if the lute could be done away with altogether, in consequence of the very great wear and tear that went on, owing to the action of the water on the lids. At the same time, he confessed that, without further information on this point, he should hesitate before adopting Mr. Green's system of fastening down the covers. He did not say it would be impossible—that would be absurd, after his experience—but he should like to know, as far as Mr. Green could give it, what the cost was, both in material and labour, of his jointing process; and also if he had noticed any chemical action taking place on the india-rubber by contact with the gas in the purifiers. He should think himself that there must be considerable labour, and a certain amount of risk; and there would probably also be some large expense in renewing the jointing material.

Mr. J. H. BREARLEY (Longwood) said Mr. Green had placed his figures before them in a remarkably lucid manner; but he should like a little further information with regard to the manner in which the oxide was taken from the revivifying cellar into the boxes again, as he could not see from the illustration that an elevator was used. He was one of the members of the Manchester District Institution who were privileged to inspect the boxes; but he did not remember seeing an elevator. In his works, he found the charge for carting the oxide round to the top again when it was revivified underneath was more than it could be done for on the same level as the boxes; and consequently he took the oxide out of the top in barrows, and revivified it in the yard, instead of in the cellar. He thought there were managers present who could testify to the fact that oxide could be worked up in five times to 50 per cent. of sulphur. He had experienced this even without the addition of air.

Mr. WILLIAM CARR (Stalybridge) said, like some other members of the Manchester District Institution, he had had the privilege of seeing these purifiers in actual work; and though he knew nothing about the cost of the rubber jointing, he could testify as to its effectiveness. He was never in a purifying-house that showed less escape of gas; and a large proportion of the purifiers were closed, and had gas passing through them at the time. Some of these purifiers, he believed, had been closed for a very long time. In fact, they had been working without the lids being taken off for a longer period than he remembered—for over twelve months. He thought it was somewhat unfair for gentlemen to ask what the cost of the purifying was, after Mr. Green had stated at the beginning that he could not give such complete details. He said he had not got the figures; and then one speaker after another wanted to know as to the difference in cost.

Mr. JOHN LYNE (Wexford) said that if he understood the matter aright, Mr. Green used a rather small opening in place of the large water-sealed cover, and employed rubber for making this small cover tight. Several gentlemen who had spoken considered this a costly joint; and he thought so too. If these comparatively small openings were desirable in such large covers, was there any reason why a water joint could not be substituted for the dry or rubber joint? With regard to the oxide changes, Mr. Green having stated that the purifiers were changed 22 times, he (the speaker) failed to understand the following sentence: "From this, taking into consideration the increase in bulk which during use takes place in the oxide, it may be assumed that the same oxide was in use in the purifiers about five times."

Mr. T. N. RITSON (Kendal) said he had recently had the privilege of seeing the purifiers at work at Preston; and he was sure it would repay any member who had not already witnessed the process to pay a visit to Mr. Green's works. There was one question he would like to ask, and that was whether Mr. Green found the gas passed evenly through the entire mass of oxide in these large purifiers; or whether there was any tendency to what he would call "stratification," owing to the gas having found an easy passage through one portion of the purifying material and left another portion unacted upon.

Mr. JOHN BOOTH (Southport) said he had seen this system at Preston. Shortly before at his own works, unfortunately for himself, he had put up a new installation of purifiers; for had he seen Mr. Green's arrangement earlier, he believed he should have introduced it. He did the next best thing, by putting up his purifiers in the way mentioned by Mr. West. With regard to increased pressure, he had found since he introduced carburetted water gas that, after carefully examining the purifiers as they were being emptied, there was a film of oil on the

oxide; and to this, and this alone, he attributed the increase in pressure.

The PRESIDENT said he should like to add a word on this paper, as Mr. Green had made him responsible for his presence—a responsibility he was very glad to accept, and he hoped that he would appear before them again. He could not let the opportunity pass without expressing his feeling of gratitude to Mr. Green for a great many useful hints. Having recently to spend an hour at Preston, he wired to his friend that he should be glad to see him. In the course of conversation, Mr. Green proposed to take him across to see these purifiers. In a few minutes, they found themselves walking over the top of the purifiers with a lantern. Of course, Mr. Green being the master he could not say much about it; but he told him that if he did that in his works, he should have sacked him on the spot. However, after thinking about it, it seemed to give him an opening which he had not previously seen his way to; and, with Mr. Green's permission he sent a draughtsman over who made such notes as enabled him to carry out the same design to suit his own place, in connection with his first water-gas plant. He got a couple of 40-foot boxes constructed; and through these they had passed the water gas from one of their plants during the last two seasons, introducing something less than ¾ per cent. of air. They ran these boxes last year for nearly six months; and when they ceased working for the season, the test was perfectly clean after passing 125 million cubic feet of gas through. A good deal had been said about the rubber. He was afraid of the effect of oil gas on rubber, though Mr. Green's experience with coal gas rendered him less timid; but he thought, as a matter of cost, he would try something else. He used ordinary yarn, twisting it round the bolts, and screwing the lids down; and they were perfectly tight. When the purifiers were opened for cleaning, they threw the yarn away, and put in fresh, which cost very little, especially as it only occurred twice a year. One was not a bit afraid of blowing. Of course, it took somewhat longer to remove the nine lids off the 40-foot box than to deal with an ordinary hydraulic cover. But they could do this and clear out the box of about 200 tons of oxide in a day, by putting a gang of men on each of the nine openings; and there was no inconvenience whatever. In these circumstances, he preferred to be without a water lute. The pressure ran up to over 30 inches; but there was no symptom of heaving or anything to apprehend.

Mr. GREEN, in reply, thanked the members for the kindly manner in which his paper had been received, and also Mr. Carr for answering the question about the cost of purification. He could not give it, for he had not come prepared. He could only look at the cost from this point of view: He was using the same oxide for his purification as was used with the sulphate of ammonia plant; and the cost of revivifying the oxide was largely mixed up together. Therefore, any figures he could give would not be of much use. But they might take it that, given a large area of purification such as he had, the gas was passing at a much slower rate, and must necessarily come into more intimate contact with the material than it would when rushing through at a high speed; and this being the case, the purifiers would naturally last longer. Again, with regard to loading and emptying, when one put a gang of ten or twelve men to shoot the stuff out and get it up, it would be done at much less cost than keeping three or four men about the place emptying or loading the purifiers day by day or week by week. And lastly all who had had experience of oxide purification were aware that one of the most important matters was revivification; for purifiers would not last if the oxide were put in warm, or even if after being cooled it was not properly revivified. In his case, he seldom emptied a purifier under a month; and the result was that the spent oxide lying about on the floor so long was properly revivified throughout; whereas if one had a system of small purifiers, it was apt to be picked up before it was properly revivified. Mr. West remarked that oxide spent after passing five times through the purifiers was a good result; but he (Mr. Green) might say it was not quite so good as appeared on the face of it, because the oxide, being used in the sulphate of ammonia plant which gave off an enormous quantity of sulphuretted hydrogen, became spent sooner than it otherwise would have been. Mr. West also said gangways could be avoided by the old system of luting. But the members must not forget that they had no mechanical appliance for loading; and this being the case, the nearer the oxide could be brought to the place where the men worked the better. If one took a purifier like this, 90 feet by 35 feet, but with water lutes and abutting against a wall, the men bringing the oxide on one side, 35 feet away from the men loading on the other side, there must be considerably more expense in filling and loading than was the case with the gangways he had described, which enabled them to bring the purifying material within some 5 or 6 feet of the men loading. The great advantage, to his mind, in these purifiers was not only the cover but the gangways, whereby it was possible to go all round and over the purifiers with the barrows, as if the tops of the purifiers were an ordinary floor. Now, with regard to the question asked by several gentlemen about the cost and durability of the rubber. The first cost was rather great; but he had had these rubber joints at work five or six years; and the same rubber was still in use. On examination, he found that the gas had no effect on it, except just on the inner edge, which came in contact with the gas. They would understand that when the lid was tightly screwed down, the gas did not come in contact with any part of the rubber, except the edge which was inside the purifier. Mr. Isaac Carr asked why he did not use air. Well, he was a little bit conservative. He did strike out sometimes, but at other periods he was rather timid; and he always had the impression that by using air there was some reduction in the illuminating power. He was told by some that there was, and by others that there was not. He was, however, rather disposed to use air; and probably he should shortly do so to some extent. If he did, probably the purifiers would last until the oxide was nearly fully charged with sulphur. With regard to back-pressure, he could not give any reason why it came so rapidly forward when the third layer got impure; but it did during the winter months. In summer, they did not feel it so much, because less gas was going through. They always tested the gas on the third layer; leaving one clean layer for the gas to pass through while they changed the other box. He always found if they waited for the third layer to show a fairly darkish test, up went the pressure. It did not creep up in a week, but in the course of one night. There might be 5-10ths on the first purifier, and the next day it would jump up to 12 or 13 inches. Why it was so, he did not know; but it was a lesson which all ought to take to heart, because where the old system of purification was in vogue, working three purifiers and one idle, and four layers of foul oxide through which the gas was passing, this to his mind accounted for the continual heavy back-pressure which existed at some of the works where oxide was used. No doubt this pointed to a fact which was not known—that if there was more foul oxide than a certain thickness, there would be a heavy back-pressure. Mr. Durkin alluded to the sulphur clauses. Probably he might have gone more into the chemical question; but he was one who believed in letting well alone, and as they were not under the sulphur clauses, he did not trouble his mind about the matter. Three or four years ago, Professor Lewes tested their gas, and found 19 grains of sulphur. If they were ever brought under the sulphur clauses, the position he should be in would be this: He might then have to bring the lime boxes first. If so, all he would have to do would be to take out the cast-iron partition, and move it to another position. He should not alter the construction, but simply remove the partition from one part to another, and have the smaller purifiers first instead of last. One gentleman asked why he did not adopt the water-lute system. It would not do to have a number of water-lutes 2 feet deep dipping down into the purifier every 15 or 20 feet. Half the depth of the purifiers would be taken up with the water-luting; and no doubt this was the reason why a number of smaller lids with water-luting were not used in one large purifier. With regard to oxide being used five times, as he had explained in the paper, though the purifiers were changed twenty-two times the same oxide only went in about five times; for if the increase in the bulk of the oxide which took place in consequence of the absorption of sulphur was brought into consideration, it would be found that the oxide which, when fresh, would be sufficient to fill a purifier (say) three times, would do so four or five times when charged with (say) 40 or 50 per cent. of sulphur. Hence the same oxide was only loaded into say every fourth

purifier, or five times out of twenty-two changes. Regarding Mr. Ritson's inquiry, on reading the paper, he would find it stated that, given reasonable care in loading the oxide, when discharged it was found to be very evenly fouled. He (Mr. Green) might, however, further add that the adoption of large purifiers with a maximum or winter's make of gas, would in effect be practically the same as small purifiers with a minimum or summer make. He thought it would be agreed that, with gas passing slowly through a purifier, there was less liability to its either rushing through the oxide in patches or blowing a hole through the oxide as was the case where the purifiers were too small for the make. If any gentlemen liked to visit his works, he would be only too pleased to let them see the purifiers. As a rule, he had not gone much among gas engineers; preferring generally to stay at home. But he was always pleased to see his friends, and was very gratified by the Manchester Institution coming over to visit his works.

INCLINED RETORTS AT SALFORD.

By S. Y. Shoubridge, of Sydenham, London.

As increasing attention is being given to inclined retorts, a short account of the installation at the Salford Gas-Works may prove of interest to the members of the Institute, for it differs in some respects from others of the kind. The Salford Corporation in the year 1893 had to build a retort-house; and in order to decide whether it should be designed for stoking machinery or for inclined retorts, the Gas Committee were authorized to visit a number of gas-works, where the best examples of both systems could be seen. The writer accompanied the deputation which was appointed; and he desires here to acknowledge the courtesy which was shown by the engineers of the works visited, who most readily afforded all the information they could give.

Reasons for Adoption.—After careful consideration of the advantages and disadvantages of both systems, as shown by the examples which they saw, the Gas Committee recommended the Council to adopt inclined retorts in preference to stoking machinery, for the following reasons: (1) Less first cost. (2) Less wear and tear. (3) Fewer men required, and these unskilled. (4) Simpler and easier to work. The Committee advised the Council not to adopt the Coze arrangement of retorts, but an improvement upon it; whereby the difficulties which were encountered in that system would be avoided.

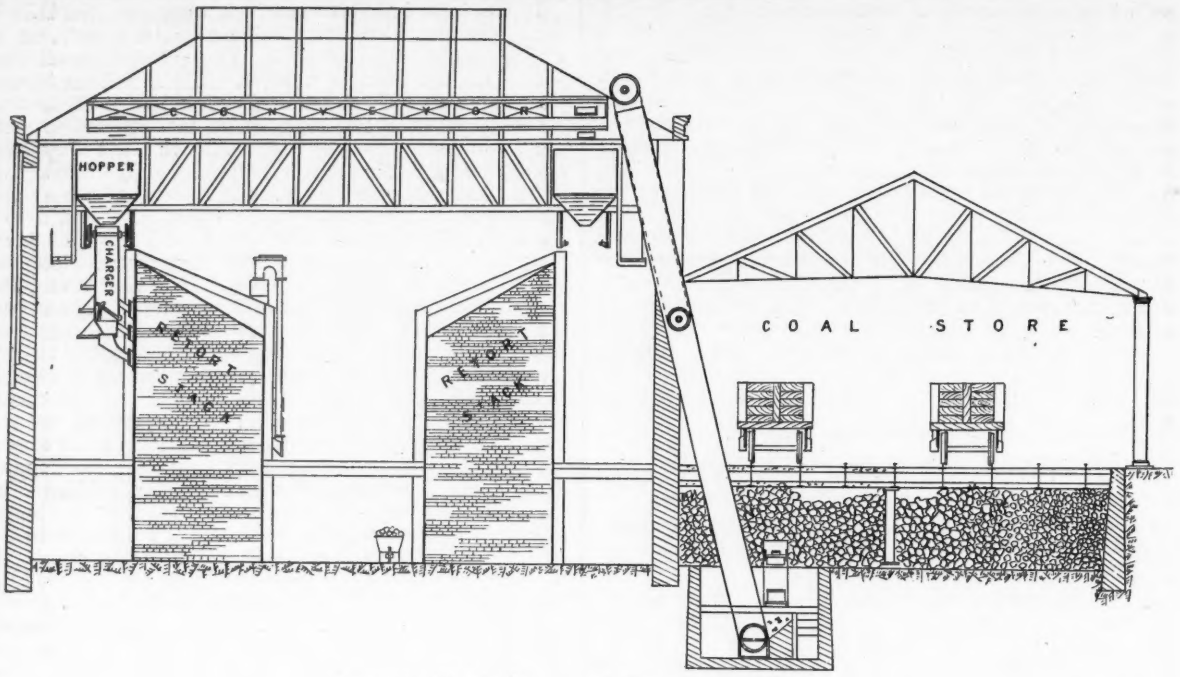
It will be remembered that in the Coze installations (some of them of considerable magnitude), each retort has a cast-iron bend at its upper end, forming the shoot through which the coal descends into the retort. This bend is built in the brickwork; and its upper end stands slightly above the top of the retort-bench. The bends are arranged so that the charging-ends are all in one line and at one level on the top of the bench, in order that they can be charged from a tipping-truck, running on rails alongside them. In practice, it has been found that these bends separate from the retorts, owing to the unequal expansion of the iron and fire-clay. The gas escapes at the joint, and, igniting there, soon burns the bends so badly as to prevent the coal sliding into the retort. Not only this, but owing to the position of the joint, it is impossible to stop the leaks effectually while the retorts are hot; and a large proportion of the gas, therefore, is wasted. Another difficulty is that tarry matter often accumulates in the bends, and prevents the even flow of coal into the retorts, so that the charging is most uncertain and irregular. On the other hand, it often happens, owing to the want of means for controlling the discharge of the coal into the retorts, that the bulk of the charge runs down to the lower end of the retort, leaving the upper part bare. The result is, of course, excessive heat at the upper end near to the bend, and insufficient heat, with consequently a large production of tar, at the lower end. So much was this the case in one of the largest installations seen, that a trough was fitted under the mouthpieces to catch the tar which ran out, and convey it to a receiver. The original Coze retort has had to be abandoned, owing to these defects, and is not now in use, the writer believes, in this country. It was very unfortunate that so many of them were erected before the system had been thoroughly tried; for not only was a large sum of money wasted thereby, but much prejudice against inclined retorts was created.

In the later installations which were seen, the built-in bend was discarded, and straight-through retorts, set at various angles, were adopted. The external shoots used with these are three in number, made to suit the several tiers of retorts. They have a bend, hinged to the bottom of the straight shoot, to facilitate the connection with the retort, and are open right through; but they have an adjustable baffle-plate fixed inside, at the lower end. They run on an overhead railway in front of the mouthpieces, and are, in some cases, supplied with coal from a truck travelling on rails above them, and in others direct from an overhead storage-hopper constructed along the whole length of the retort-bench. In either event, the coal falls from one level to the three tiers of retorts; and there is therefore a greater drop to the middle tier than to the upper, and a greater drop to the bottom tier than to the middle. As a consequence, the momentum of the coal in charging differs in each tier of retorts; and this causes uneven charges and imperfect carbonization. It was soon seen by those who adopted this arrangement that it was necessary to devise means for regulating the impetus of the coal. An attempt was made to effect this by fixing the adjustable baffle-plate in the mouth of the shoot before referred to, so as to offer more or less resistance to the coal, according to the angle at which it was fixed. It was intended that the stoker should adjust this plate to suit the quality of the coal, whether fine or large, so as to give an even distribution in the retort. This contrivance improved the charging somewhat; but owing to the difficulty of regulating the flow of coal when falling with considerable velocity, and also to the carelessness of the workmen, the charging was often very unsatisfactory, and the coal accumulated at the lower end of the retort—causing not only bad carbonization, but considerable labour in getting the coke out. The drawing, in some cases, was almost as laborious as with horizontal retorts. A great improvement was made by Mr. Braidwood, of the Greenwich Gas-Works, who patented an arrangement of charger and shoot, whereby the coal is discharged gradually into the shoots, and its impetus regulated by a series of baffle-plates arranged so that the coal falls from one to the other in its passage down the shoot.

Charging.—When designing the Salford installation, it appeared to the writer that, instead of discharging the coal into open-ended shoots of different lengths from one level, and checking the flow into the retort by placing obstacles in the way of the coal, it would be better to find out the proper height of fall required to give even charges, and then to deliver the coal from this height to each tier of retorts. In order to effect this, a charging-machine having three measuring-chambers and sliding-shoots was devised. Each measuring-chamber is constructed to hold rather more than the maximum charge required, and has a hinged door at the bottom, counter-weighted so as to close automatically. When closed, the door is held fast by a weighted catch. These doors are inclined so as to deliver the coal into the shoots beneath in the opposite direction to the retort; and by an arrangement of lever and stop, they can be quickly adjusted to open to any desired extent, so that the volume of the stream of coal flowing into the retort can be controlled to a nicety. The discharging doors of the three chambers are fixed at the same relative height above the retorts they have to charge, so that there is a uniform drop and momentum of the coal to every retort in the setting. Each measuring chamber is provided with an adjustable flap-door, covering an opening in the front of the charger. By this means, the quantity of coal per charge can be speedily and accurately regulated, as required.

The measurement of the charge is very simple and certain. Having fixed the flap-door at the height necessary for the charge, the attendant allows the coal to run from the overhead hopper into the charger until it reaches the door and opens it, showing that the proper quantity has been put in. The supply is then shut off. To vary the quantity of the charge, all that is necessary is to slide the door up or down, and so increase or diminish the size of the measuring-chamber. The charger is suspended from an overhead tramway; and when loaded with three charges of coal, it can be easily and quickly moved by one man. It is supplied with coal from a storage-hopper placed above and midway along the retort-bench; continuous hoppers being quite unnecessary.

The numerous experiments which have been made with the charger, have proved that an even charge throughout



INCLINED RETORTS AT THE SALFORD GAS-WORKS.

the retort can be obtained with certainty, with any description of screened or unscreened coal that has passed through the breaker, and this without any skill on the part of the attendant, who has simply to release the catch, pull a handle, and wait until the coal has run into the retort. The labour of charging is thus reduced to the minimum, and made as pleasant and simple as possible for the men. The men employed at Salford to charge and draw these retorts had never been engaged in a gas-works previously; and they performed their duties admirably, in a very short time—no skill or training being necessary. Two men in each shift charge the eight beds of retorts in the bench, and attend to the elevator and conveyor; and they could easily do more. Perfect charging having been obtained in this way, the even heating of the retorts and the automatic discharge of the coke are assured. In Salford, one man in each shift does all the work of discharging the coke from eight beds of retorts, including the opening and closing of the retort-lids. He also removes and replaces the stoppers (which keep the coal off the mouthpieces), and clears the ascension-pipes.

General Arrangement.—The retort-house, which measures 228 feet long, by 85 feet wide, by 49 feet high, was constructed to contain four benches of retorts; each bench consisting of eight beds of nine retorts, or 288 in all. At present, only two benches are erected. The coal-store is parallel with and adjoins the retort-house, and is arranged so that the coal falls direct from the railway-trucks into the coal-breaker, whence it is elevated to the overhead store-hoppers in the retort-house. One breaker and one elevator serve two benches; the coal being conveyed across the house in a scraper conveyor. The breaker, elevator, and conveyors are driven by a 14-horse power gas-engine, which has been found to be a most convenient and economical motor for the purpose; the consumption of gas being less than 15 cubic feet per ton of coal carbonized.

The first retort-bench was built in 1893, and the second in 1896, by the regular staff of retort-setters employed at the works. In the first bench, the settings contained nine retorts each, and in the second only seven; it having been found that the heating of the smaller number is the more satisfactory. The retorts are ⌂ shape, 18 feet long on the slope, 21 inches by 16 inches at the top, widening gradually to 23 inches by 16 inches at the bottom. By tapering the retorts in this way, the friction of the coke against the sides is obviated, and the discharging greatly facilitated. In fact, so rapid is the discharge that the man who removes the stoppers has to be very careful to prevent the coke from rushing out too quickly. The angle at which the retorts are set is 32°, which has been found to be suitable both for charging and discharging. They are heated by regenerator furnaces of a simple and effective design, one to each setting. The charging ends of the retorts are toward the sides of the retort-house; the coke being discharged in the centre. This arrangement was adopted as being most convenient for the removal of the coke, which falls through shoots into barrows on the ground floor, and is then quenched and wheeled to the yard at both ends of the house. The coke-floor being of cast-iron plates bedded on concrete, makes the wheeling of the coke a very easy matter. The discharging-floor is constructed of iron plates on girders; and the charging-floor, of girders and concrete.

First Cost.—The cost of the installation, excluding the retort-house, but including everything else above the foundation of the benches—*i.e.*, all brickwork in the arches and piers, regenerators, settings, flues and chimneys, retorts and fire-bricks, the charging, discharging, and coke floors, all the ironwork of the benches and floors, and chimneys, columns and girders, buckstays, mouthpieces, ascension-pipes, hydraulic mains, gas and tar mains, valves, gas-engine, coal-breaker, elevator and conveyors, overhead store-hoppers and charging machine, &c.—works out to about £63 per mouthpiece, without royalty. An installation of horizontal retorts in a stage-floor house, built as far as possible under the same conditions as to strength, size of retorts, furnaces, &c., and equipped with power stoking-machinery, would cost about £76 per mouthpiece. There is, therefore, a very substantial difference in favour of inclined retorts.

Cost of Working.—In working inclined retorts, there is no saving in wages in the matter of foremen, firing, or coke-wheeling, which are the same as with horizontal retorts. The saving arises in the charging and drawing, and in conveying the coal to the retorts. At Salford, the charges for this work are as under—

Inclined Retorts.

No. of retorts, 112; coal carbonized, 134 tons per 24 hours.

Number.	Men Employed.	Rate.	Total.	Cost per Ton Carbonized.
	Class.	s. d.	£ s. d.	
6	Chargers	5 0	1 10 0	
6	Drawers	5 0	1 10 0	
6	Hoppermen	4 0	1 4 0	
2	Enginemen	4 4	0 8 8	
			4 12 8	8·29d.
2	Coal unloaders . . .	..	0 11 2	1·00
	Gas used in breaking, elevating, and conveying, oil, waste, and sundries.	..	0 8 4	0·75
22	Totals	..	5 12 2	10·04d.

The cost for similar work in the horizontal retorts worked by hand, is as follows:—

Horizontal Retorts at Salford.—Hand Charging.

No. of retorts, 192; coal carbonized, 237 tons per 24 hours.

Number.	Men Employed.	Rate.	Total.	Cost per Ton Carbonized.
	Class.	s. d.	£ s. d.	
68	Stokers.	5 0	17 0 0	
17	Coal wheelers. . . .	4 0	3 8 0	
1	Hoistman	4 0	0 4 0	
1	Engine and boiler man .	4 4	0 4 4	1s. 9·08d.
			20 16 4	
4	Coal unloaders . . .	..	0 19 9	0 1·00
	Fuel, water, oil, waste, and sundries per ton .	..	0 14 10	0 0·75
91	Totals	..	22 10 11	1s. 10·83d.

The cost by the hydraulic machinery used in another retort-house is given in the following table:—

Machine Charging at Salford.

No. of retorts, 140; coal carbonized, 168 tons per 24 hours.

Number.	Men Employed.	Rate.	Total.	Cost per Ton Carbonized.
	Class.	s. d.	£ s. d.	
6	Chargers	5 6	1 13 0	
6	Drawers	5 3	1 11 6	
6	Backers-up	5 0	1 10 0	
6	Lid-openers and pipe-jumpers	5 0	1 10 0	
6	Coal-breaker attendants .	3 6	1 1 0	
3	Enginemen	4 4	0 13 0	
1	Fitter	5 4	0 5 4	
1	Boilerman	4 4	0 4 4	
35			8 8 2	
10	Less value of the firing done by these men . .	..	2 10 0	
25			5 18 2	8·44d.
5	Coal unloaders	..	1 4 6	1·75
	Fuel, water, oil, waste, and sundries per ton . . .	..	1 1 0	1·50
30	Totals	..	8 3 8	11·69d.

It must be borne in mind that these figures are the actual costs paid at Salford, under the conditions as to rates of wages, peculiarities of retort-houses and surroundings, &c., which prevail there. Probably better results, so far as the cost of working goes, are obtained elsewhere with larger installations worked under more favourable conditions. This applies to all three systems.

Time occupied in Charging.—The average time occupied in charging and drawing the inclined retorts, from the opening of the first lid to the closing of the last, on a draw, averages a trifle over one minute per retort; and the charging is, to say the least, as well done as it can be by the most perfect charging-machines, while the discharging is easier and quicker than is possible by machinery, however perfect.

Wear and Tear.—The first bench of inclined retorts at Salford (which it should be remembered was built by men who had had no previous experience with inclined retorts, and with retorts made by a firm who had not produced this kind before) worked for 1092 days before resetting. This is not a bad record for a first setting; but the second lot put in will, of course, last much longer, for there will be no further shrinkage of the brickwork of the bench. There is every reason, therefore, to expect that the durability of inclined retorts will be greater than of the horizontal type. This is not remarkable when it is remembered that no rakes or scoops are put into them, and that the evenness of the charges equalizes the strains imposed. The wear and tear of the machinery and gas-engine have been very slight. In two years, the cost of labour and material used on repairs to engine, coal-breaker, elevator, conveyor, and charging-machine was £13.

Gas Produced, Illuminating Power, and Residuals.—As the inclined retorts form but a small proportion of the total number at Salford, it has not been possible to work them entirely by themselves for a long period. But they were worked independently for about six weeks in the summer; and the results, both in yield per ton and illuminating power, were found to be practically the same as obtained from horizontal retorts—the difference being slightly in favour of the slopers. It was not, however, possible to determine the yield of tar and ammoniacal liquor separately. All that can be said is that the total yield of these residuals per ton has not diminished, nor perceptibly increased, since the inclined retorts have been at work. The quantity of coke per ton is the same in both systems; but the quality is slightly superior from the inclined retorts. Altogether the results have been so satisfactory that the Gas Committee have decided to adopt inclined retorts exclusively in future, and to convert the existing horizontal settings to this system as opportunity offers.

In view of its many advantages, it is difficult to understand why the inclined system has not been more largely adopted in this country. Possibly the early failures have done a great deal to retard it, and also the heavy royalties. But there are now many successful installations at work in this country and on the Continent; and when the royalties cease by the expiration of the Coze patent in June of next year, there is no doubt it will be greatly extended.

In conclusion, the writer desires to express his obligations to Mr. Woodward and Mr. Hartley, the present Engineer and Assistant Engineer of the Salford Gas Department, for the great assistance they rendered him in constructing and perfecting the installation described.

Discussion.

Mr. David Terrace (Middlesbrough) said Mr. Shoubridge had put the case for inclined retorts very well. In Middlesbrough they worked on much the same lines; but with one or two slight differences in details. Instead of a triple shoot, they had separate shoots (on Mr. Shoubridge's principle), one for each level of retorts, which he thought an advantage because, not only could the charging be done very simply, but they were much lighter. Instead of the central tank arrangement, they had the old continuous hoppers, so that the single shoot was charged immediately from them. Instead of having to travel to the centre and back again, they charged from the coal immediately overhead. They were now working the inclined retorts by themselves, and found the cost something like half what it was with horizontals—namely, 1s. 10d. instead of 3s. 4d. per ton, including taking the coal from the store or the truck, until the coke was put into the yard; neither of which was included in Mr. Shoubridge's figures. They worked a steam-engine, though a gas-engine would be better; but they had an old steam-engine which was made use of. He was quite satisfied that inclined retorts were the retorts of the future, and that horizontals would disappear in time. In comparing inclined retorts with machine stoking, the size of the works must be taken into account. No doubt machinery was good for large works which could keep it in constant action; but for medium-sized works, he thought inclined retorts preferable. Mr. Shoubridge had not said anything about the creeping of the coal after it was put into the retort. They used Durham coal exclusively—twelve different kinds, one of which did creep; but the others remained perfectly as they were laid.

Mr. J. F. Bromley (Batley) said Mr. Shoubridge seemed to have combined in his charging apparatus some of the best points to be found elsewhere. They used shoots similar to those referred to by Mr. Terrace; but the best of them were faulty as to level charging. Take one line of retorts—the top lot, for instance—and charge a dozen. Eight of them would be beautifully charged; but in the other four most of the coal would be at the bottom or occupying about two-thirds of the retort, and the other one-third with no coal in would be white hot. In another case, some of the coal would stop in the middle; tapering one way or the other. This in a measure arose, he believed, from the coal—especially the fine coal—taking fire instantly and sticking to the bottom of the retort. In other instances, the coal would be nearly all at the top. If something could be devised by which this could be altered, and uniform charges put in, it would be a great improvement. His idea was that it would be better to use double screened nuts. He had tried them, and found they could put in level charges; but with coal of different sorts, some screened and some unscreened, the charges could not be put in uniformly, resulting in the charge being about half burnt off. Another point was that it was said one man did the whole of the work of the drawing stage for eight arches of sevens. He thought this was a little too much; and he should not like to ask any man under him to attempt

it. One man might do on the charging stage; but certainly not less than two on the drawing stage. With regard to the expeditious manner in which the coke was discharged from the retorts, this was all right enough when the charges were thoroughly burnt off; but if they were not, there was considerable difficulty in getting them out.

Mr. W. A. Valon (Ramsgate) congratulated Mr. Shoubridge on his admirable paper. He had had the pleasure of visiting the works at Salford; and most certainly, of all the installations of sloping retorts he had seen, it was one of the prettiest and most successful. Still, he was not converted to this principle as superseding horizontals, and hesitated to believe that the days of horizontals were numbered. He looked upon the sloping retort as a valuable additional mode of carbonizing coal under certain circumstances; but he did not think, all things being equal, that there was anything to warrant the belief that they would drive the others out of the market. Mr. Shoubridge commenced by recommending the retorts for certain reasons; but he would suggest that these reasons were all arrived at before he tried them. Very likely his experience with the retorts afterwards confirmed the reasons for having adopted them; but they could not well be the reasons for their being adopted. In the paper the whole cost per mouthpiece was put at £63, and that of horizontal retorts and machinery at £76. He presumed this meant that one sloping retort cost £126; while the cost of the other would be twice £76. His own opinion, deduced from experience, was that the erection and construction of sloping retorts were very much more expensive than with horizontals, leaving machinery out of the question. They had to be built higher; and the retort-house itself must be higher. The only thing, as far as he could judge, in which there was any saving was in ground space, which, in some cases where new works were not being laid out, was of great consequence. But, putting all this aside, he did not think that the comparison between sloping and horizontal retorts was in favour of the former. In comparing the cost with other systems, he thought it had been kept down on one side—he did not say purposely or unfairly—and fully charged on the other. For instance, in Mr. Shoubridge's paper, on the machinery side six coal-breaking attendants had been charged, but under the heading of inclined retorts nothing was charged; and it seemed to him that coal breaking was as necessary in the one case as in the other. Then there was a charge for a fitter and boiler man on the one side, which did not appear on the other. Of course, with the gas-engine a boilerman was not required; and perhaps, the installation being new, a fitter had not yet been wanted. Nevertheless, these men were needed at some time; and though the installation was new, this should be taken into consideration. The comparison was between machine-charged retorts which had been at work for some time, and the new system. Now as the machinery in use at Salford was of a somewhat antiquated type, he did not think this was a fair comparison with sloping retorts of the newest and most approved pattern; and he thought the best possible system of carbonizing coal by machinery should be compared with what was acknowledged to be the very best mode of using sloping retorts. It was impossible to discuss a paper where the line was drawn at certain particulars and others were not given, so as to arrive fairly at what would be the expenditure in both cases for cost and maintenance. He hoped at some time they would have a paper dealing with all these details succinctly. The other day Mr. Harman in London gave as the figure for hand labour, 1s. 6d. per ton; for inclined retorts, 10d.; and for stoking machinery, 4½d. Mr. Tysoe, of the South Metropolitan Gas Company, a short time since gave 1s. 3½d. per ton with West's machinery as the total cost of the coal from the retort-house to the coke-yard, including everything. If they could get a corresponding figure for sloping retorts to that given by Mr. Tysoe, and it compared favourably, he should be glad to have it. He was still in favour of horizontal retorts charged and drawn by the best kind of stoking machinery; and, all things being equal, he was convinced, from study of the subject, that with a fair balance struck as to first expenditure, maintenance, and cost of carbonizing, the relative make per mouthpiece with the same size and length of retort, taken as it should be taken as a whole, horizontal retorts were at the present time more economical to construct and work than sloping ones. At the same time, he fully agreed that the erection of sloping retorts might be justified by circumstances.

Mr. Alexander Wilson (Glasgow) said he had had a good deal of experience with machine charging; and on taking out the corresponding charges at their works to compare with those stated in the paper, adding up the different items, they worked out to £6 16s. 6d. for 240 tons, as against £8 8s. 2d. for 168 tons carbonized at Salford. Adding the same proportion for fuel, water, oil, waste, and sundries—1·5d.—gave on the same lines, with 1d. per ton for coal unloading, a total of 9·33d., against the figures given by Mr. Shoubridge of 11·69d. for machines and 10·04d. for inclined retorts. One gentleman spoke about the uncertainty of charging the inclined retorts. With machine stoking there was no uncertainty. The retorts could be charged just as they chose—either level, or if one end were hotter they could put in a heavier charge—and if, as sometimes happened, one part was found duller, they could keep part of the charge out, which could not be done with inclined retorts. The time for charging and drawing was stated to be about one minute; they never exceeded this at Glasgow. Their men did about forty retorts per hour; and the charging time was 35 minutes on the average. It had been done in 25 minutes. They were getting over the difficulty about ground space by putting in settings of twelve where they had only eight before, and heightening the machines. With hand charging they could only get up to a certain height. Mr. Stelfox showed them the previous day how much higher they were able to go in Belfast; but he did not think they could get men generally to charge such high retorts as he had. With machinery one could go to any reasonable height; and he did not know that they were going to stop at twelve. It was merely a question of getting equal heats over the setting. Coal breaking and machine charging required a great deal of attention; but he did not think six coal-breaker attendants were necessary for 168 tons per day. At Dawsholm, they had only three coal-breaker men for 240 tons—one on each shift.

Mr. H. Hawkins (Todmorden) said a few years ago the inclined system was adopted at Todmorden; the retorts being 20 feet in length, set at an angle of 32°. In his first season's experience, he had a great deal of difficulty in connection with the charging. In the first place, they found that, however careful they were in putting in the charges, before they were long in, the retort was completely bunged up at the bottom. These retorts were tapered 4 inches; and the coal used was slack. They did not get any round coal at all. He also found by slackening off the bottom cover about half an hour after the charge was in, that the coal had swollen up and got almost to the top of the retort. This impeded the progress of the gas to the ascension-pipe; and so they were troubled with a large number of stopped ascension-pipes. He paid great attention to that; and very often during the day men had to go to the same ascension-pipe several times. The cause he found to be that the coal, when put into the retort at a certain speed, caused an amount of dust to come forward, which accumulated with the tarry matter; and, when taken out, it was found to be simply coal dust. This difficulty had since been overcome. They were now putting in a fresh arrangement; the Council having just decided on the matter—viz., working with one bed as through retorts, putting the mouthpieces at the top, with ascension-pipes also on the bed of the hydraulic main, and connecting the two with the foul main. It would be completed in about three weeks; and they were looking forward to testing it during the summer months. He felt sure that the days of horizontal retorts were numbered, and was satisfied that inclined retorts were far cheaper when properly worked. He could not say he obtained such excellent results as Mr. Shoubridge mentioned; for men would not work in Yorkshire as they did in Lancashire. He was looking forward to the results of one bed with the eight retorts; and if it was satisfactory, no doubt the Committee would give him permission to go on with the whole lot.

Mr. C. A. Craven (Dewsbury) said some time ago he had a great prejudice against inclined retorts; for he went to some places (which he would not particularize), and was not favourably impressed by them. Since then, however, the system had made great progress; and to-day he was prepared to corroborate the opinion of Mr. Hawkins, that greater progress would be made by inclined retorts than by horizontals, and that more installations of them would be put up. At Dewsbury, they had put in an installation of eight sets in one bench, and eight retorts per set. They

had working about Christmas time six beds of horizontals in sevens, and four beds of inclined retorts in eights; and with regard to wages, there were eighteen men on the horizontals, and nine men and an engineman on the slopers. They made more gas with the ten men than with the eighteen. He did not find any difficulty at all about the charging. Everyone commencing the new system would find many difficulties at the beginning; but it was only a question of attention. Everyone who went in for the system must be prepared to give a good deal of care to it; and eventually, he believed, they would overcome the difficulties. Their retorts were 20 feet long, eight in a setting; and they were getting 130,000 cubic feet of gas per 24 hours, charging every six hours. He did not quite agree with Mr. Shoubridge, with regard to his storage. He preferred to have a single hopper for each set. They had storage for ten tons, in each hopper, and had three fixed measuring chambers for each bed, holding about 8 cwt. each, which gave 11 tons 5 cwt. of storage. By so doing, he got the coal elevated during a portion of the day, and had no machinery going at night. The machinery was actuated by a 10-horse power gas-engine, which worked admirably. It did not cost more than ½d. per ton for crushing, elevating, and conveying to the hoppers. If the coal was dropped into elevated hoppers at one point only, no doubt in some parts the round coal would go to the sides, and the small to another place; and, when this was the case, they did not charge so well. For every hopper they had three slides; so that they could direct the discharge of the coal in the first section, and then follow with the others, and thus get a better and more equal size of coal througout the bunker. He agreed with Mr. Shoubridge in his remarks with regard to the quantity and quality of the gas and tar and ammoniacal liquor. He could not thoroughly substantiate the two latter items; but he was certain that the gas required less cannel to keep up the standard. With regard to tar, he was under great apprehension at one time that it would be too thick—and, in fact, the tar contractor told him before beginning the work that he probably should not be able to pay the same price for it. Yet, though they obtained very good heats—indeed, if they liked they could easily burn the stack down—he was glad to say they had had no difficulty whatever about the tar. He thought it was rather thinner than before. He was inclined to agree with Mr. Bromley that the labour Mr. Shoubridge had put down was rather too little. At Dewsbury they were working on a more liberal scale. With regard to the general saving in wear and tear, this was most decided; the advantage lay with slopers as compared with machinery. The firing cost very little; about 14 lbs. of coke per 100 lbs. of coal carbonized amply sufficed for the Dewsbury inclined-retort installation. They had elevators and crushers in duplicate. The railway went immediately past the end of the retort-house; and they had a sliding arrangement with shoots and stops to regulate the speed, which almost worked automatically. All the attendance required was that of a youth to pick out anything the colliers might leave in the coal. Sometimes they would leave wedges, or perhaps the top part of a pick. He did not think it was done intentionally; but still it wanted looking after. He arranged the check-stops so as to divide the coal into two streams; and the youth who looked after the coal delivery had within reach a lever, by which he could stop the machinery instantaneously, and re-start it again as required. Then, with regard to labour, now they had got down to two beds, it was a great difficulty, as it cost more in labour than when one employed more retorts. It was possible to work more economically with a whole set of four, six, or eight beds; when one got below four, it was necessary to leave the eight-hour shift, and adopt what the men called twelve-hour shifts, but which were really ten-hour shifts. All this work could be done in the ordinary way, with more than two beds, for 1s. 2d. per ton, embracing everything—and including a leading stoker—and he found there was a great saving over the old system. In large works, where they could keep a full set of retorts going all the year round, considerable saving would be effected over any other system.

Mr. Isaac Carr (Widnes) said he had had an opportunity of inspecting the inclined retorts at Salford, and was very pleased to agree with Mr. Valon in saying that it was certainly one of the finest installations—if not the finest—in the whole country. It reflected the greatest credit on Mr. Shoubridge's constructive ability and mechanical ingenuity. The paper was an excellent one for inclined retorts; but he was not sure it was so excellent against them—*i.e.*, that difficulties which had to be encountered had not been mentioned. They had had a little of the other side from Mr. Bromley, who said something about coal creeping. Then there was another common term in connection with inclined retorts, known as "tickling." These were pretty names, which the stokers understood very well, and had peculiar ways of giving expression to. He had seen an inclined retort tickled; and he must say he would rather have drawn half a dozen horizontals than tickle that one inclined. At the same time, in common fairness to Mr. Shoubridge, he must say that this did not occur at Salford. The installation there worked like a charm. At the time he saw it, the coke came out without any difficulty. He believed the retorts were subject to certain vagaries with the coal. While one class of coal did very well, with other classes of different sizes or quality all sorts of difficulties arose. With regard to the comparative cost of the erection, he should have liked to know the author's cost of erecting horizontal retorts without stoking machinery. Mr. Shoubridge gave a figure of £13, or £6 10s. per annum for maintenance of the gas-engine and machinery; but he trusted he did not ask them to accept that in all seriousness as the cost of maintaining the big installation for a period of two years. Rakes and shovels could not be bought for any system of ordinary retorts for this money that would keep them going for a quarter of the time. It might be that everything being perfectly new, it did work for this time at the low cost named; but he (Mr. Carr) could not accept it as being the cost at which it was possible to maintain such a plant. With regard to the figure of 10d. and a fraction per ton for the cost of carbonizing, it was certainly very wonderful, if true. He said "if true" because he feared that the figure was not inclusive of all the charges of the carbonizing department; for on turning to other works where nothing but inclined retorts were employed, as given in "Field's Analysis," he found, in the case of Brentford, that the cost of carbonizing was put as 2s. a ton. He wanted to know how it was that at Salford they could do it for less than half the money.

Mr. George Tooley (Leeds) said his Committee visited Mr. Shoubridge's works, and also those at Brentford; and from the information obtained from them they decided to put up something like 200 retorts, which he expected to get into work when he returned home. One very important point had been missed in the discussion, though Mr. Craven just touched on it. Mr. Shoubridge—like Leeds—was in a hot-bed of Unionism, and suffered from the difficulties which arose when some big man came from London and persuaded the men that they had a grievance which they did not know before, and that they ought to have more money and do less work. This led him and his Committee to put up inclined retorts. They were in the same position at Leeds. The point was this: In a retort-house (and he had three) with 300 men to handle, if they got obnoxious, it was a very great gain if the number could be reduced by half. He expected to do more than this, when the system was put to work.

Mr. J. P. Leather (Burnley) said, after his experience of about eight years with inclined retorts, he was still in favour of them as compared with horizontals, though he did not say that at his works he had all the advantages he might if he were putting up a new installation now. Mr. Shoubridge's was erected after seeing his and others; and he was able to hit upon an improvement which Mr. Terrace had himself adopted to some extent. With reference to Mr. Valon's remarks, the points put forward in the paper as reasons for adopting these retorts, were found by experience to be good reasons for putting up others when the time came. The first reason was smaller first cost. This was a rather difficult question, as there were so many different ways of designing a retort-house for either inclined or horizontal retorts. It was easy to spend the £76 per mouthpiece Mr. Shoubridge mentioned on horizontals; and it was possible to put them in for less even with machinery. Their cost for inclined retorts, 15 feet long, would come to rather less than £63 per 10 feet, as stated in the paper. But there was also a saving in the retort-house. When the house was built, they were not quite sure which system would be adopted. It was only decided to have inclined retorts when the house was nearly finished; and all they had to do was to add 2 feet to the height. The width was the same; and they got 30 feet of inclined retorts, in place

of only 20 feet of horizontals—that was, two 15 feet set the opposite way to Mr. Shoubridge's, with the charging stage in the middle. This he still thought rather the better plan, though in his case they were a little bit too close together. Then with regard to wear and tear, as they were first put up the wear and tear would be a little bit more. It was certainly necessary to make everything good and strong and well stayed at the bottom, to prevent slipping and spreading out. If once it came out, there was no putting it back. If inclined retorts were well set and stayed in the first instance, their experience was that they would last longer than horizontals. His second lot, put up in 1892, were still in use, though they had not been worked so fully. Still, they had gone four good seasons, and were ready for work again. The saving in labour was nearly 1d. per 1000 cubic feet as compared with West's manual stoking machinery used on other parts of the works.

Mr. JOHN WEST (Manchester) said everybody appeared to be so satisfied with what he was using himself, that it seemed a most pleasant position for those present to listen to them. He had seen Mr. Shoubridge's installation, and had been much impressed by it. It was undoubtedly the best piece of construction in connection with inclined retort work he had seen; and for moderate and small-sized works, he was disposed to think Mr. Shoubridge's arrangement of a travelling shoot was most economical. He did not propose to go into the relative cost of the different systems. He built both, and should be prepared to take any number of orders for retort-houses on the horizontal system—including machinery—at the same price as was paid for the inclined system. With regard to the saving, various things had to be taken into consideration—particularly the relative size of the works, and the position each manager was in when he required to make extensions. There were situations in which he should be disposed to recommend slopers. This would be in a narrow house, where one could not get in manual or power machinery. When there were a large number of retorts which could be worked continuously, there was no doubt that power machinery was by far the cheapest method of carbonization. Mr. Wilson had given figures of what they were doing in Glasgow up to a certain point; and Mr. Valon, inclusive figures for the South Metropolitan Company. In all cases, it would be well to get a figure including everything, from the taking of the coal from the store to the tipping of the coke in the yard. This would include the tickling business in connection with the inclined retorts, which had been referred to. There were great differences of opinion as regards the cost of working. The other day he heard Mr. Harman read a paper before the Society of Engineers, giving his practical experience of carbonizing by hand labour, power machinery, and inclined retorts. He did not take the whole of the charges into account; but picked out the relative number of men and cost per ton of coal carbonized for simply drawing and charging the retorts under each system. He gave the cost of hand labour at 1s. 6d. per ton; inclined retorts, at 10d.; and power machinery, at 4½d. The previous week Mr. Marshall gave the cost at 1s. 6d. per ton; but to this he added afterwards 3d. for getting in the coal and taking out the coke, He was glad to hear from Mr. Terrace that his total figure was 1s. 10d. per ton. He wanted to get the total figure as a basis to guide managers, though personally he did not care which system was adopted. Each had a certain amount of machinery connected with it; and this would suit him. He thought inclined retorts might go on; but he did not believe the horizontals would be knocked out any more than electricity would knock out gas.

Mr. R. H. TOWNSLEY (Leeds) said he had followed the paper with very great interest; and he was sure the members were indebted to Mr. Shoubridge for bringing before them a subject which was at the present time exercising the minds of most engineers, particularly those who had extensions in hand, and had not made up their minds as to what system of carbonization to adopt. As most of the members would be aware, they had erected at Leeds what he believed to be the largest installation of inclined retorts in England. They proposed starting them during July; and he would be pleased on a future occasion to give the members some information as to their working. With regard to the relative results obtained from the two systems of machine stoking and inclined retorts, they had had great diversity of opinion that morning; but he failed to see how any fair comparison could be made without taking into consideration the conditions as to wages and surroundings of the various works mentioned. They all knew that no two works were alike; and for this reason, what could be accomplished in one place was impossible in another. Seeing, however, that Mr. Shoubridge had the two systems working under similar conditions and surroundings, he (Mr. Townsley) thought the information he had given was reliable, and proved that the cost of working with the inclined retorts was less than that of machine stoking. He was very much surprised, when reading the discussion on Mr. Marshall's paper the previous week in London, to find that several engineers had experienced a "creeping" of the coal in the retorts, more especially those who carbonized Durham coal. Mr. Shoubridge, speaking on this subject, mentioned that he had not had any creeping with the Lancashire coal he used. He (Mr. Townsley) would like to ask him if he had employed Yorkshire coal, and, if so, whether he had had any difficulty in this respect. As at Leeds they used coal from about thirty different collieries, the matter was of great importance to them. There was no doubt the system of carbonization by inclined retorts had a great future before it; and, in his opinion, it would very largely supplant horizontal retorts.

Mr. ROBERT PORTER (Elland) said he might give a few figures with regard to the cost at Elland. He had put in an installation of retorts with 64 mouthpieces, together with an elevator and conveying and charging machinery; and the total cost was £41 per mouthpiece, including West's manual stoking machinery. The settings were eights, fired with generator furnaces; and the smallest production per bed was 65,000 cubic feet in 24 hours. He named this because Mr. Craven gave a valuable figure as the production of a through setting of eight inclined retorts at 130,000 cubic feet per 24 hours. This was equal to two single beds, or one through bed of horizontal retorts. This gave 65,000 cubic feet per single bed—the same as he was getting with eight beds of eights. But this was only with six-hour charges; and it could be considerably increased if required. He might further refer to an installation now being put up which, including elevating and conveying machinery for taking the coal from the canal boat and delivering it opposite the retort mouthpieces ready for hand charging, and including also regenerative furnaces, stage floor, and all new ironwork complete, was to cost £55 per mouthpiece. He thought these figures compared most favourably with those given in the paper; and that from them it would appear the advantages claimed for increased production of gas in the inclined settings were not so large.

The PRESIDENT said this had been a very useful discussion; and both sides of the question had been put forward. He had not seen all the installations of inclined retorts; but he must say that if ever he wished to induce anyone to give them a trial, he should send him to Salford. With the exception of the setting he saw of Mr. Braidwood's some years ago, and that at Salford, he had not had the pleasure of looking at any which did not require to be tickled before giving up their contents.

Mr. SHOUBRIDGE, in reply, said he was very pleased to find that his paper had produced such a good discussion, which more than repaid him for the trouble he had taken in writing it. His object was not to institute a comparison between inclined retorts and stoking machinery, but simply to describe what had actually taken place at Salford. The necessities of the case, however, compelled him to bring in the question of stoking machinery, because it was the competing system; and all gas engineers must decide between the two, when considering extensions and the building of large retort-houses. He went round to various works to see what had been done before commencing to design the retort-house which had been described. Mr. Valon's remark that his reasons for adopting inclined retorts must have been arrived at after, not before, erecting them was a mistake, because his Committee formed the opinion from what they saw, and from the figures given them, that there would be less wear and tear, less first cost, &c.; and the facts had thoroughly confirmed this. As to separate shoots and a continuous hopper, which Mr. Terrace preferred, this was a matter of opinion. At Salford, they found no difficulty in working with a single hopper in the centre of the bench; and it was a much cheaper arrangement than a continuous hopper. With regard to the charger, in large installations probably single or double shoots worked on this plan would be better than

triple shoots; but for somewhat small installations, such as that at Salford, the triple shoots were to be preferred. Mr. Terrace and several others called attention to the creeping of the coal. He did not mention it in the paper, because he had experienced no trouble in this respect, though there was no doubt it was a difficulty with some kinds of coal. Mr. Frank Livesey had pointed this out recently; and others had noticed the same thing. He had tried all kinds of Lancashire coal, cannel, and a good many varieties of Yorkshire coal, and had never found creeping to take place with them. Before coming to the meeting, he wished to verify the matter; and on his way he called at Salford and inspected a large number of retorts which had been charged, both at the top and the bottom, and made further inquiries. This fully confirmed his experience while there, that creeping did not take place with the kinds of coal he had mentioned. No doubt it did occur with some sorts of Durham coal; but it was a difficulty that probably could be overcome by adopting special means. Mr. Bromley seemed to think he had condemned separate shoots; but it was not so. He only pointed out that with these shoots, which had no means of controlling the flow of the coal, one did not get an even charge. The great difficulties in getting out the coke, and the blocking up of the retorts which had been alluded to, had arisen from the coal being put into the retorts without proper regulation. It did not do to deliver the coal from one level to three tiers of retorts without regulation; but where the flow of the coal was properly controlled, the charging was absolutely even with any sort of coal of which he had had experience. The coal did not block up the bottom of the retort. The carbonizing was just the same as with the horizontals; and the coke came out like an avalanche. Mr. Valon was still a firm believer in horizontals and stoking machinery, and so were several other speakers; and there was no doubt that in very large installations stoking machinery gave excellent results, and would work as cheaply as inclined retorts. The difference was in the first cost and in the maintenance. Those who, like himself, had had lengthened experience of stoking machinery as well as inclined retorts, would know that after a time there was considerable wear and tear, and more trouble in looking after the machinery than there was with inclined retorts. Mr. Valon thought there was no saving in the first cost compared with horizontal retorts worked without machinery, except economy of ground space. This was wrong; for with the inclined retorts only one hydraulic main and one set of ascension-pipes were required. This made a considerable difference in the cost, and went far to compensate for the additional brickwork needed. It must be remembered also that though one had to increase the height of the brickwork with inclined settings, the width was diminished; and he had found, after taking careful account of the cost of inclined and horizontal settings, that there was no more expense in building inclined retorts than horizontal retorts in a stage-floor house. In reply to Mr. Carr's question, it cost about £62 per mouthpiece at Salford to build horizontal retorts, in the same way so far as the size of retorts, description of furnace, &c., in a stage-floor house without machinery; but he was aware that it could be done for less. The cost depended on the design of the setting, and the prices of the materials, which varied in different localities. In writing the paper he did not desire to hold up the Salford installation as the best, and one for everybody to imitate, but simply to show what had been done there. They could all form their own conclusions, and improve on his plan, as much as he hoped he had improved on some others. It was only one step in the progress of the inclined system. Mr. Valon thought that, in giving the account of the cost of working, he had cut it down in some way, so that it did not compare fairly with machine charging. He had not cut anything down or put anything in; he simply took the actual cost of the working from the books. The figures were not arranged to show up one system, or to run another down, as had been suggested. The same gentleman called attention to the coal-breaker attendants. At Salford, they had a peculiar arrangement of coal conveyor, which necessitated two men filling the scoops as they went up; and this caused the cost of the work to be larger than it was in other installations where these men were not needed. If he had to describe an ideal system, he should have given the best possible results in each case; but he had not done so. He had given the exact cost of the working at Salford. Mr. Leather and Mr. Craven thought the figure he had stated as the cost of working inclined retorts was a great deal too favourable. But they seemed to have overlooked the fact that it did not include taking the coke out of the retort-house or the firing. It was not an inclusive figure. The 10d. therefore must not be compared with other figures where all charges were included. The Salford installation, he was aware, owing to local conditions, was not the best so far as cost of working went. Mr. Craven had got his total figure down to 1s. 2d. They could not do this at Salford. They started with an installation having only eight beds in line, which was not sufficient for the most profitable employment of the men. In other places, where there was a much larger number of retorts in use, better results were attained. The total cost at Salford worked out to about 1s. 9d., all included; but it had been done for much less in other works. If they had the best possible arrangement of inclined retorts, he thought the cost would compare favourably with the best possible arrangement of stoking machinery, such as Mr. West had given. With a large house, in which stoking machinery dealt with thirty settings of tens, the cost would naturally be very low; but it depended so much on local conditions that fair comparisons were very difficult to make. Mr. Bromley said he was struck with the fact that only one man was required in drawing eight beds of retorts, and said it could not be done. He could only say that it was done every day; and the man was not overworked either. Opening and shutting the lids and putting in the stoppers was practically all he had to do. In some works, there had been a great deal of the tickling which Mr. Carr spoke about; but this was owing to the charging being bad, so that the coal had gone to the bottom and swelled, and jammed in the retort. In such a case, it needed a great deal of tickling to get the coke out. Some people who erected inclined retorts, knowing they would not require to use rakes, had reduced the depth of the retort; and this, of course, had added considerably to the difficulty. Mr. Wilson pointed out that there was no uncertainty in machine charging. This was quite true; but there was also no uncertainty in charging the inclined retorts at Salford. In some other places, he was aware the charging had not been very regular. Mr. Hawkins referred to the difficulty of stopped pipes; but this was a trouble which some of them had had with horizontal retorts. There had been only one stopped pipe in the Salford installation since it started. Stopped pipes were not a necessary consequence of inclined retorts; and with a proper arrangement of the hydraulic main, they could prevent them, both with the inclineds and horizontals. Mr. West asked for complete figures; but he had designedly not put them in his paper, because in his opinion they were confusing when they dealt with the coke which was removed from retort-houses in all sorts of ways. There were, however, some figures in the records of the Institute which might be referred to, and Mr. Craven had given one in the discussion. It should be remembered that stoking machinery had been in use for very many years, and had had the advantage of the most painstaking and thorough work of Mr. West and others, who had done wonders in improving it, and had brought it to a very high pitch of perfection. The inclined-retort system was in its infancy; but when it had been going on for twenty years, probably very different results would be obtained. Speaking generally, all he could say was that his faith in inclined retorts was stronger than ever; and he believed they would see a great increase in the number of them erected during the next few years.

STANDARDIZING OF METER UNIONS.

By Robert S. Carlow, of Arbroath.

The reading of this paper—some extracts from which were given last week, p. 1551—gave rise to the following

Discussion.

Mr. Alexander Wilson (Glasgow), who was one of the members of the Sub-Committee, said their first idea was to make the work of small managers as easy as possible when they had to change a meter; but as soon as they commenced to think about the matter, they found that, though it pressed somewhat hardly on the managers of small works, the expense in connection with large works was very serious, and it was not thought very much about

because they got into a sort of rut. If a standard, or a set of standards, were adopted, the change of meters, both for large and small companies, would be very much simplified; and the idea was to try and get a standard set for themselves. They thought that, if they went into a scheme for obtaining a standard for the whole country, it might be very difficult to arrange; but if they took the matter in hand for Scotland, they might settle it for themselves. They had arranged it to their satisfaction; and a standard was about to be brought into operation, when they were met by the communication from Mr. Chaney. It would have been a very serious matter if, after agreeing to a certain set of standards, the Board of Trade had stepped in, and another standard, which might or might not be as good, were introduced. And so it was thought better to leave the matter over, and get the assistance of The Gas Institute and the Institution of Gas Engineers, so as to have the matter finally settled. There could be only one view about it. The unions adopted were chosen as being suitable for both large and small companies; and making them with the Whitworth thread, it was thought that if a union happened to get squeezed, the manager might take his ordinary gas-thread tap and make it right again without much trouble. If a Joint Committee could be arranged of the North British Association and The Gas Institute, they might go over the matter again, and perhaps find a better standard; but they would be glad to adopt any system that would suit the convenience of all. The benefit in the course of a few years would be great, and would be worth all the trouble which had been taken.

Mr. J. P. Leather (Burnley) said the question was very simple. No doubt it would be an advantage to all works if the unions were alike; but he did not understand what the Board of Trade had to do with it. Whatever standard was adopted, if his Committee did not like it they would not have it. If he wanted a special standard, he asked the meter manufacturers to make it; and he found they were prepared to supply him. He had meter makers coming to him to ask for a share of his orders, who told him that if he ordered even half a dozen meters they would make any union he desired. He had given an order for half a dozen; and they were made just to his union, without any difficulty. He had about 20,000 meters in use, about 14,000 of which were made to one set of unions; while among the other 6000 there were perhaps twenty or thirty different makes. As the old meters came in for repair, he put in in most cases standard unions, or where practicable changing the ring and tail-piece—perhaps putting a die on to the other part to make them fit. If some decision could be come to which accorded pretty much with his own practice, he should be ready to go along with them; but if they were very different, he should probably keep to his own sizes.

Mr. J. W. Glover (London) said to his mind it was a matter really of supply and demand. The experience narrated by Mr. Carlow, though limited to Scotland, would have led them to see the inutility of the suggestion made at an early stage of the discussion—that, if the matter were laid before the meter makers, they would of their own initiative adopt a uniform standard. The duty of a meter maker was to suit the convenience of his customers; and this was best done in each locality by the maker continuing to supply meters with similar connections to those he had sent out ten or fifteen years before. Hence, each variety of pattern became stereotyped. If the Institute could influence the members of this and similar societies, and so create a general demand for meters with connections universally interchangeable, they would have taken the most effective step towards what Mr. Carlow rightly called "an eminently desirable reform." The Board of Trade could do nothing without an Act of Parliament or an Order in Council. If this course were taken, there would no doubt be a provision in the Sales of Gas Act that no meter should be stamped unless it had the standard connections; and then at once there would be a legal standard fixed for all time. Hence the importance of discussing the subject, and informing the Board of Trade as to the best and most convenient standard to be adopted. In London, The Gaslight and Coke Company did exactly what Mr. Leather had described. They insisted on a standard of their own; and some years ago steel gauges were prepared to which all makers supplying the Company must conform. The Company's meters of a given size were now interchangeable. This referred to over a quarter of a million meters. The meters sent out by his firm were all of a similar pattern to those of The Gaslight and Coke Company, unless otherwise specially ordered; and he believed that for more than half a century some makers had been sending out unions which were interchangeable. He had brought with him two dry meters more than fifty years old—one a 3-light, by Richards, dated 1846, and the other a 5-light of obsolete pattern, of which the unions were practically the same as those being sent out to-day. And the same unions he found interchangeable, in several instances, with both Scotch and English meters of these sizes. The one practical suggestion he had to offer was that they should not only confer with the Institution of Gas Engineers and the Board of Trade, but with The Gaslight and Coke Company, and any others who had standards of their own, so as to arrive, if possible, at only one standard, instead of several as at present, varying more or less in the different sizes of meters.

Mr. John West (Manchester) considered this was a very simple matter. Engineers all used the Whitworth thread; and he did not think they need go to the Board of Trade. The meter makers were reasonable men; and the best plan would be to accept the proposal of the Scottish Association, that a Committee of the Institute should be formed to deal with this matter. He should suggest that they should appoint themselves engineers, and draw up a specification; and the whole thing could be speedily settled. Of course, they would specify that all meter connections should be of the Whitworth thread; but the whole of England must combine. If a meeting were called of the whole of the meter makers of the United Kingdom, they would be found to be reasonable business men, and would fall into line and meet the suggestions at once.

Mr. J. L. Cloudsley (London) said uniformity was gradually increasing; and in a short time he believed it would be accomplished. If the Whitworth thread were adopted generally, an enormous expense would be involved, as they would have to change nearly all the meters in the United Kingdom. He thought it would be much better to let things go on as they were; and in a short time matters would adjust themselves.

Mr. West said he was speaking for the future. He was not going back to the past.

Mr. Thomas Wilson (Coatbridge) said they would all agree with Mr. Carlow that, in the interest of everyone concerned, meters should be made with couplings of a uniform pattern. The North British Association did not want them to adopt the couplings that they had selected, but any that might be approved of generally. Even in a small town, where they had to change 500 meters in a year, a considerable saving would be effected by uniformity.

Mr. T. O. Paterson (Birkenhead) said this was a matter of detail, which could hardly be settled at such a meeting as the present one.

Alderman John Miles (Bolton) said he was prepared to move a resolution that the Council be requested to put themselves in communication with the Institution of Gas Engineers, and also with the North British Association of Gas Managers, with a view to arriving at a standrad for the United Kingdom.

The President said there might be some difficulty in getting two or three associations to meet together; and he suggested that the resolution should be to refer the matter to the Council to consider what steps should be taken.

Alderman Miles said he would gladly accept the suggestion, and would move the resolution in that form.

Mr. Alexander Wilson seconded the resolution, which was carried unanimously.

THE NECESSITY FOR AMENDMENTS IN THE GAS-WORKS CLAUSES ACTS, 1847 AND 1871.

By W. F. Cotton, of Dublin.

[Taken as read.]

In dealing with the subject of this paper, it will be unnecessary for me, before a gathering of gas managers, to go into minute detail; and I therefore purpose to commence by stating briefly the relations existing between the undertakers (gas companies), local authorities, and private consumers. I am convinced that few gas managers have not, at one time or another, felt the necessity for amending the Gas-Works Clauses Act, 1871. The Act, as it stands, is very loosely framed. Many of the clauses are defective—thus causing from time to time differences between gas

undertakings and local authorities, and sometimes private consumers, very often ending in litigation. I will simply give a few examples of the most glaring defects in the Act, which in my opinion should be amended.

Private Consumers.—By the 13th section of the Gas-Works Clauses Act, 1847, it is enacted that: "The undertakers may from time to time enter into any contract with any person for lighting or supplying with gas any public or private building, or for providing any person with pipes, burners, meters, and lamps, and for the repair thereof, and may also from time to time enter into any contract with the commissioners, trustees, or other persons having control of the streets within the limits of the Special Act, for lighting the same or any of them with gas, and for providing such commissioners, trustees, or persons with lamps, lamp-posts, burners, and pipes for such purpose, and for the repairs thereof, in such manner and upon such terms as shall be agreed upon between the undertakers and the said commissioners, trustees, or other persons." Here we have an enabling, as distinguished from a mandatory or compulsory, section.

Section 11 of the Gas-Works Clauses Act, 1871, enacts that the undertakers shall, upon being required so to do by the owner or occupier of any premises situate within 25 yards of any main of the undertakers (or such distance as may be prescribed by the Special Act), give and continue to give a supply of gas for such premises, and further that they shall furnish and lay any pipe that may be necessary for such purpose, subject to the conditions following: "The cost of so much of any pipe as may be laid upon the property of such owner, or in the possession of such occupier, and of so much of any such pipe as may be laid for a greater distance than 30 feet from any pipe of the undertakers, although not on such property, shall be defrayed by such owner or occupier." The section then points out the manner in which the owner or occupier requiring a supply shall proceed; and it entitles the undertakers to require the owner or occupier to enter into a written contract to continue to receive and pay for a supply of gas for a period of at least two years, of such an amount that the sum payable shall not be less than £20 per cent. per annum on the outlay incurred in providing the pipe, and further imposes on the owner or occupier the obligation of giving security for the payment of all moneys which may become due. Now this section differs materially from section 13 of the Act of 1847, to which I have previously referred, inasmuch as it makes it compulsory on the undertakers to supply gas to the owner or occupier of any premises within the limits stated, and also to provide and lay the necessary service, and to bear the cost of such service up to a distance of 30 feet, provided it is not laid on private property (and not, as in the Act of 1847, which throws the whole cost on the owner or occupier); and in return for this outlay, the undertakers are entitled to require the owner or occupier to enter into a two years' contract.

Public Lighting.—Until the passing of the Gas-Works Clauses Act, 1871, the supplying of gas, services, and the repairs of same, to local authorities, were matters of contract (Section 13, Act 1847). But—as in the case of private consumers—section 24 of the Act of 1871 imposes on the undertakers the obligation of supplying gas to any public lamps within the distance of 50 yards from any of the mains of the undertakers in such quantities as the local authority may from time to time require—"the price to be charged for all gas so supplied to be settled by agreement, and in case of difference, by arbitration; regard being had to the circumstances of the case, and the prices charged to private consumers in the district." This section, it will be observed, is altogether silent on the subject of the supplying and laying of services, and, as I contend, only makes it imperative on the undertakers to supply gas; leaving the supplying and laying of pipes, repairs, &c., in the same position (as between the undertakers and local authorities) as it stood under section 13 of the Act of 1847—namely, one of agreement or contract. However, this, as will be seen from the following facts, is not the view of the Irish Courts.

For a period extending over fifty years, a Gas Company carried out works in connection with the public lighting of a city, at the expense of the Local Authority. The right of the Company to charge for the works so executed, including long service-pipes, was not disputed until the year 1894. The general nature of the work done may be classified into expense incurred for the removal of public lamps (the property of the Local Authority), the cutting off of gas from the public lamps, the resuming and connecting of same, and several alterations, such as change of site, all being carried out by direction of the Authority; also the laying of services to new lamps—the works being paid for without dispute, in accordance with their nature.

In 1893, the Local Authority refused to pay for this work, and referred the Company to the Gas-Works Clauses Act, 1871, section 24, under which they alleged that the Company were bound to carry out all similar works free of expense to the Local Authority; the Gas-Works Clauses Act, 1871, being incorporated with the Company's Acts. The Company, on the other hand, contended that the obligation imposed on them by the 24th section was to supply gas, and that in supplying gas they were not under any obligation to lay down apparatus and carry out from time to time numerous descriptions of alterations free of expense to the Authority. The Local Authority argued that the true meaning of the 24th section was that the Company were bound to supply the apparatus necessary to make the gas available for illuminating purposes, in order to comply with the obligation of the statute, and were also bound to lay the necessary services and apparatus up to, and connect same to the uprights of, the public lamps without charge, so long as the distance from a main to the lamp to be supplied did not exceed 50 yards.

Ultimately the Company were obliged to sue the Local Authority for works executed between the years 1890 and 1894. When the case went into Court, the Judge held that, in order to find out what the Legislature meant by section 24 in the Act of 1871, it was necessary to go back to the Gas-Works Clauses Act, 1847, section 13; so much of the provisions of that Act as were not inconsistent being incorporated with the Company's Special Act of 1866. Section 13 of that Act enacts that "the undertakers may from time to time enter into any contract with any person (the word "person" includes corporation), for lighting or supplying with gas any public or private building, or for providing any person with pipes, burners, meters, and lamps, and for the repair thereof; and may also from time to time enter into any contract with the commissioners, trustees, or other persons having the control of the streets within the limits of the Special Act, for lighting the same or any of them with gas, and for providing such commissioners, trustees, or persons with lamps, lamp-posts, burners, and pipes for such purpose, and for the repairs thereof, in such manner and upon such terms as shall be agreed upon between the undertakers and the said commissioners, trustees, or other persons."

It is evident from this section that there is a clear distinction drawn between the gas, and the service-pipes, connections, meters, &c., which makes it available for use. It is also clear that the Legislature contemplated the making of contracts between the local authorities and gas undertakers. To use the words of the Judge who tried the case, "It was an enabling, as distinguished from a compulsory, clause; and the object the Legislature had in view in framing the 24th section of the Act of 1871, was to make it compulsory on all incorporated gas undertakings who had incorporated the Gas-Works Clauses Act of 1847, to supply gas to any lamp or lamps within 50 yards of the mains of a company," and that section 13 of the 1847 Act may be read together with section 24 of the 1871 Act.

It was pointed out that before the passing of the Act of 1871, local authorities had merely enabling powers, under the 13th section of the Act of 1847, which placed them in a position to agree with gas undertakings in relation to supplying them with gas at a price to be fixed, and for the execution of works—such as the alteration of lamps, the supply of pipes, the laying of new services, &c., in connection with the lighting of a city, on terms to be agreed upon. It may be taken for granted that in the framing of the Act of 1871, the Legislature, seeing that to a great extent gas undertakings had a monopoly, had a reasonable amount of obligations cast upon them, such as would not leave their dealings with local authorities merely questions of contract; and hence the introduction into the Act of 1871 of section 24, making it compulsory on gas undertakings to supply gas to public lamps if they were within 50 yards of a company's mains, and also providing for the manner in which the gas was to be estimated and paid for.

For some time previous to the passing of the Act of 1871, the Legislature had awakened to the fact that private consumers were suffering an injustice by reason of gas

companies supplying gas to public lamps at a price much under that which large consumers were paying—and, in fact, in many cases at a loss, which loss had to be made good by the private consumer. The result was that in numerous Acts of Parliament a clause was introduced stipulating that the price to be charged for gas supplied to the public lamps should be the lowest price charged to private consumers. Is it at all probable that, under such circumstances, the Legislature intended that all such preliminary works connected with a supply of gas to public lamps for lighting a city should be executed at the cost of the undertakers, or free of expense to the local authority? while in the 11th section of the same Act, when dealing with private consumers, two things are to be considered; one being the gas to be supplied into the private consumers' premises, and the other the expense incurred by the company in laying pipes to meters, &c.—ample provision being made for a reasonable division of the cost between the consumer and the company.

However, in the case I refer to, after two days' hearing, the Judge ruled that the Company were entitled to payment for the works executed to the order of the Local Authority; merely leaving to the Jury the prices charged for labour, materials, &c., and a few minor matters, such as whether they conceived they were reasonably compensated for the work done. The Jury found for the Company to the sum of £307 18s.; the amount claimed being £308. Against this finding, the Local Authority appealed. The appeal was subsequently heard in the Queen's Bench Division by four Judges, with the result that they found the Company were subject to the 24th section of the Gas-Works Clauses Act, 1871; that "the Legislature enacted as it had been done in that statute, that the undertakers shall supply gas to any public lamps within 50 yards of any of their mains;" that "the natural meaning of this language is, that anything which may be required to bring the gas to the lamps must be done by the undertakers;" and that, "so far as finding in the enactment anything to support the contention that the work is not to be paid for, they thought there was an express direction to the contrary." The Judges contended that, in fixing the price of gas under section 24 of the Act, with one exception—viz., the charge for connecting meters in the event of an average-meter system—all items should be sunk in the price charged per 1000 cubic feet; or, in other words, when fixing the price for public lighting by arbitration under the 27th section of the Act or otherwise, the whole service should be included. They altogether ignored the 13th section of the Gas-Works Clauses Act, 1847, as having no bearing on the case, and disallowed the charges.

Assuming the ruling of the Judges of the Queen's Bench Division to be correct, no stronger evidence for amending the Act of 1871 could be adduced; for in fixing the price under the 24th section, it would be utterly impossible to say what amount per 1000 cubic feet should be included to cover the alterations and shifting of lamps and services, the number and cost of services up to and under 50 yards for new lamps, alterations of sites, &c., without doing an injustice either to the local authority or the undertakers. Until the law in this respect is amended, undertakers, when fixing the price for public lighting, must take care, in making contracts or settling the price by arbitration, to be on the safe side, and add sufficient to cover all such items, though doing so can be nothing more than guess-work, as it would be impossible to arrive at it correctly.

It may be mentioned that in the case I refer to, when the award under which the price of gas for public lighting was fixed was under discussion, none of the items similar to those disallowed were taken into consideration. The question did not arise; such items having been paid for under a contract for an average-meter system that had been in operation for years. Moreover, one of the conditions of the award is that "the average-meter system shall continue to be used as heretofore." It never entered the minds of anyone connected with the undertakers that such items would be disputed—in fact, the arbitration was to fix the price of gas per 1000 cubic feet, no question of supplying pipes or carrying out alterations being brought before the Arbitrators.

Testing.—I now come to the testing of the illuminating power and purity of gas. By the 28th section of the Gas-Works Clauses Act, 1871, it is enacted that the undertakers shall provide, at the spot prescribed, a testing-place, with apparatus, for the purposes following, or such of them as may be prescribed by the Special Act: (1) For testing the illuminating power of the gas supplied. (2) For testing the presence of sulphuretted hydrogen in the gas supplied. The apparatus must be in accordance with the regulations prescribed in Part I. of Schedule A to the Act, or according to such rules as may from time to time be substituted in lieu thereof by any Special Act, and shall be so situated and arranged as to be used for the purpose of testing the illuminating power and purity of the gas. Turning to Schedule A, Part I., we find: "The apparatus for testing the illuminating power of the gas shall consist of the improved form of Bunsen's photometer known as Letheby's open 60-inch photometer, or the Evans enclosed 100-inch photometer, together with a proper meter, minute clock, governor, pressure-gauge, and balance;" the burner employed to be such as shall be prescribed by the Special Act.

It is clear that the Act of 1871 contemplated the use of Letheby and Evans photometers of the type then known. Their definition, however, was left sufficiently loose to enable numerous so-called improvements and alterations to be made in them; the result being that in the apparatus of the present day, the original types are scarcely to be recognized. I shall not waste your time by giving in detail the numerous alterations which photometers have undergone; no doubt they are known to you. Unfortunately, most of the so-called improvements have been detrimental to the suppliers of gas. In my opinion, there ought to be one standard photometer, or at the outside two—a Letheby and an Evans—and that a full description of them should have been scheduled to the Act of 1871, not only for the sake of uniformity, but also to prevent the imposition on suppliers of gas of photometers which were not contemplated by the Legislature, many of which were altered with a view of compelling undertakers to supply gas of a higher standard than intended.

In Schedule A, Part I., of the same Act, it is enacted "that the burner to be used for testing the gas shall be such as shall be prescribed"—meaning prescribed by the Special Act. It is hard to comprehend why the framers of the Act omitted to prescribe the burner to be used for testing gas of different qualities, more especially for 14, 15, and 16 candle power (one or other of such standards being almost universally adopted), instead of leaving them questions which have had to be fought out on many occasions in Committees in the Lords or Commons. I cannot see that any sound reason exists against the Standards Department of the Board of Trade being called upon to define burners for different qualities of gas. Such burners should be standardized and scheduled to the Act under discussion, as it must be evident to those conversant with the question, that the test-burner is one of the chief factors in arriving at the quality of the gas under testing.

Under section 29, the local authority of any district within the limits of the Special Act where the gas is not supplied by such local authority, "may, after the passing of the Special Act, appoint a competent and impartial person to be gas examiner to test at the testing-place provided in conformity with the provisions of the Act, the illuminating power and purity of the gas on any or every day," between the hours therein named. And under section 30, "where the testing of the gas is imperfectly attended to by the local authority, two Justices, on the application of not less than five consumers, may by order in writing appoint some competent and impartial person to be gas examiner; and such person may, at any time within the hours aforesaid, on producing said order, enter on the premises of the undertakers, and there test the illuminating power and purity of the gas supplied by them.

The 29th section referred to, clearly enacts that the gas examiner so appointed is not alone to be a competent but also an impartial person. Unfortunately, these conditions are as a rule lost sight of when appointments are being made; and in some cases the office is conferred upon persons who are known to be hostile to gas undertakings when managed by companies. It should be made clear that no appointment be held valid, if the person so appointed be an officer of the local authority or other body appointing him, or receiving salary or emolument from them, or holding an office the nature of which places him in a position antagonistic to the undertakers. An officer in the position of a gas examiner should be without bias in favour of his employer, and should be as unprejudiced, and as disinterested, as a Judge.

Section 31 of the Act enacts—"the undertakers may, if they think fit, on each occasion of the testing of the gas by the gas examiner be represented by some officer; but such officer shall not interfere in the testing." Numerous constructions have been applied to this section. In most cases gas examiners contend that the representative of the undertakers is not entitled to occupy a position which will enable him to check the observations or readings of the disc of the photometer, the weighing of the candles, or the consumption of gas. I hold that, so long as a representative of the undertakers does not interfere with the testing, he should be entitled to an opportunity of witnessing every operation in connection with it; but, unfortunately, the powers of a representative being undefined, in many cases advantage is taken of this omission to throw obstacles in his way, and prevent him fulfilling the functions which were evidently intended by the Legislature.

A case is known to me, where a gas examiner absolutely obliges the representative of the undertakers to take up a position at the end of a photometer next the gas-burner (the photometer being an Evans); and should he attempt even to move, he is immediately told by the examiner that he is interfering with the testing, while a person who accompanies the examiner under the guise of an assistant takes a note of the objection. From the position occupied by the representative, it is impossible to see the weighing of the candles, the disc of the photometer, or the consumption of gas. In this same case, the representative is not allowed to see the results of the observations recorded, which are supposed to be entered in a small note-book held by the examiner.

No secret should exist in the matter of testing gas. Everything connected therewith should be open and above-board, as in London, where the books containing the records of testings are at all stations open to the inspection of representatives of the undertakers, and the results recorded in their presence. A like rule should be in force for all gas undertakings. The Act should be amended, so as to permit the representative of the undertakers to occupy a position in the testing-station which will enable him to see the test carried out in accordance with the rules laid down in Part II., Schedule A, of the Act. This could be done without interfering in any way with the testing.

The results of the examiner's observations should be recorded in presence of the representative, who should see the candles prepared and weighed, and go over the records or calculations requisite to neutralize the effects of the difference of weight above or below the standard quality. The consumption of gas should be regulated to 5 cubic feet per hour; and if during the testing either an increase or decrease of the consumption takes place, the calculations necessary to neutralize the effects should also be recorded. The representative should be permitted to take readings of the disc during the experiment. This would not interfere with the examiner. The book in which the records are made should be open to the inspection of the representative, or other officer of the undertaking.

Among other provisions, the 34th section of the Act of 1871 should be amended by altering the number of persons who shall be entitled to accompany the gas examiner, or representative of the local authority, at the testing-place. At present the number is unlimited; and I have known cases where eight or ten persons have been present, consisting of aldermen, town councillors, the gas examiner, and other persons under the title of experts. Under such circumstances, it would be impossible to test gas properly.

Penalties.—Under the head of penalties (section 36), the undertakers are liable to a penalty not exceeding £20 on any day the gas supplied is of less pressure, less illuminating power, or less purity than it ought to be. I venture to suggest that few having the management of gas undertakings are aware that failure in the illuminating power to the extent of a tenth of a candle renders the undertakers liable to a penalty of £20, which may be levied at the discretion of any Justice, regardless of the size of the undertaking, so long as it is within the Act under discussion. In London, a margin of half a candle is allowed; the highest penalty that can be inflicted there being £2 for the first half candle of deficient power, after a series of tests. Thus, while a London undertaking carbonizing 2 million tons of coal per annum is only liable to a penalty of £2 for a failure to the extent of half a candle, most other undertakings are liable to a penalty of £20 for a failure to the extent of a tenth of a candle. I am not suggesting that £2 is not sufficient—on the contrary, I consider it ample, as failures, when they do occur, I believe to be beyond the control of the parties responsible. No undertaking could afford to risk systematically avoiding its parliamentary obligations by supplying gas under the standard.

Similar penalties are in force for excess of impurities and failure of pressure. There are some incorporated gas undertakings who have special provisions in their Acts, modifying the above penalties; but they are very few indeed.

Out-Going Tenant.—There are many other sections in the Acts which require amendment. For instance, where a consumer who is indebted to the undertakers for gas for one set of premises, takes possession of other premises from which the gas supply has not been discontinued, from failure of the out-going tenant to give notice of his intention to leave, section 11 of the Act of 1871 makes no provision for the incoming tenant giving notice to the undertakers; nor is there any clause in that Act dealing with it. Section 15 enacts that no consumer shall connect a meter; but here we are dealing with a case where the meter has not been disconnected. Under such circumstances, the only alternative is to serve the consumer with a seven days' notice to provide security, under section 11; failing which the gas supply can be discontinued. But if the consumer complies with the notice, and gives security before the gas is disconnected, such supply cannot be interfered with for non-payment of a debt incurred for the lighting of other premises. The Act should provide that a person entering premises where the gas has not been discontinued should be bound, under penalty, to give notice that he has become a tenant of other premises, and give notice to the undertakers of his intention to take a supply of gas; and payment should be made for any gas consumed on the premises vacated. The undertakers should be empowered to discontinue the supply so long as the consumer is indebted to them. It would be well, also, if a similar power existed with regard to meter-rent, stove-hire, engine-hire, &c.

Conclusion.—I think it will be agreed that, owing to the lapse of 27 years since the passing of the Act of 1871, the time has arrived when Parliament should amend it.

A proper description of the photometers should be scheduled to the Act, in addition to a notification of the burners to be used in testing.

The 24th section should be altered so as to make it clear that when fixing the price of gas to local authorities, either by agreement or arbitration, the price so fixed should include gas only. All doubt should be removed as to whether the cost is to include services, alterations, shifting of lamps, &c.

The 29th section should be amended to provide that persons appointed as gas examiners should not only be competent and impartial, but also be independent of the authority from whom they receive their appointments; and section 31 requires amending to enable the representative of the undertakers to occupy a position in the testing-station that will enable him to fulfil the functions which Parliament evidently intended—namely, to check the experiment being carried out by the gas examiner.

Section 34 should set out clearly the person or number of persons entitled to accompany the gas examiner to the testing-station.

Provision should be made to enable the undertakers to withhold a supply of gas from a new tenant, so long as he is indebted to the undertakers for premises which he has vacated.

The penalties clause should be modified.

LABORATORY NOTES.

By JOHN T. SHEARD, of Sheffield.

[Taken as read.]

I.—*On Gas Analysis.*

The analysis of gases for technical purposes has of late years received considerable attention. Among the best known and most deserving of the many forms of apparatus which have been devised for this analysis, that of Hempel occupies a foremost place. As commonly employed, however, Hempel's apparatus, while furnishing results sufficiently correct, for practical purposes, of some of the more important constituents of coal gas, is not very

suitable for complete analyses. The object of the present "Note" is to describe a modification of Hempel's apparatus, which—without departing from the simplicity of construction and ease of application which are so marked features of that apparatus—is capable of affording, with careful manipulation, results of considerable exactitude in a complete analysis.

Referring to fig. 1, the burette A has a Greiner-Friedrichs stopcock D, and is connected to one limb of a manometer or pressure-gauge F, whose other limb is connected to a "correction tube" B, which is filled with air at atmospheric pressure, and saturated with aqueous vapour. Both burette and correction tube are enclosed in the same water-jacket C, which ensures that the gas in the burette and the air in the correction tube are exposed to the same temperature, while also maintaining, to some extent, equability of temperature during the continuance of an analysis. The burette is connected by rubber tubing to the level-bulb, or reservoir of mercury, H, with which the burette is charged; and, before and after each absorption, mercury is run into or out of the burette, until the level of the liquid is the same in the two limbs of the pressure-gauge F—showing that the contained gas is at atmospheric pressure. The volume of gas in the burette is then read off directly; no correction for either pressure or temperature being required. All this is more fully described and explained in Hempel's "Methods of Gas Analysis" (see p. 28), to which reference may be made for fuller details.

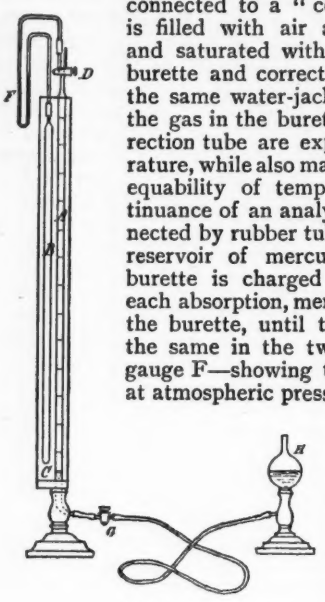


FIG. 1.

The modification to which attention is directed by this "Note" is in connection with the pressure-gauge F. In Hempel's book (and as ordinarily supplied), this is about 6 mm. wide, and is charged with the same liquid—water or mercury—which is employed as the containing fluid in the burette. As there is an appreciable space for gas in the pressure-gauge between the level of the liquid and the burette, directions are given for determining the size of this space, for which a correction must be made at each measurement of the gas in the burette. Furthermore, the gas therein contained must be drawn over into the burette before each absorption, to ensure its being acted upon. Thus the arrangement occasions very considerable trouble and inconvenience.

To obviate the need for any correction, and to facilitate the adjustment of the volume of gas in the burette, and thereby its correct measurement, the writer makes the pressure-gauge F of capillary tube, charged with water; while mercury is employed in the burette. (With this apparatus, mercury is as easy of manipulation as water; and the readings are obtained more quickly, as there is no waiting, as with water, for the liquid to settle down from the sides of the burette. A drop of water, introduced at the commencement of the analysis, ensures the gas being saturated with moisture; and besides, at each reading, the contents of the burette are put into communication with the water in the pressure-gauge.) By having water in the gauge and mercury in the burette, very accurate readings are obtained with great facility. Water is 13½ times lighter than mercury; therefore, a difference of 1-16-inch in the levels of the liquid in the two limbs of the pressure-gauge, which is readily noticed by the eye, represents a very trifling—indeed, an inappreciable—amount measured by the mercury in the burette.

For the determination of the absorbable constituents of coal gas, the writer follows the lines laid down by Professor Lewes in a paper read before the London Section of the Society of Chemical Industry,* with the exception that, with mercury as the confining fluid, fuming sulphuric acid is conveniently employed, instead of bromine, to remove the unsaturated hydrocarbons.

In the explosion pipette, in which methane and hydrogen are burnt, the writer has found it of advantage to have a stopcock above as well as below the bulb, as shown at A in fig. 2. Care should, however, be taken, before exploding, to have a little mercury in the capillary tube to protect the upper stopcock. The moveable bulb or reservoir of mercury B enables the pressure on the gas in the explosion bulb to be increased or diminished, according as a weak or a strongly explosive mixture is contained therein; thus ensuring more complete combustion, or reducing the liability to shatter the bulb, as the case requires.

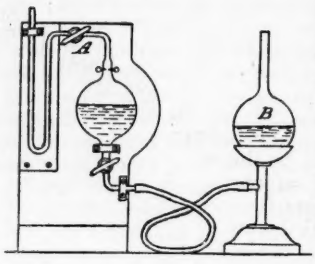


FIG. 2.

For the correct determination of nitrogen, a check explosion of the original gas, with subsequent absorption of carbon dioxide and oxygen, should, as pointed out by Professor Lewes (*loc. cit.*), always be made.

II.—*On the Determination of Cyanogen in Ammoniacal Liquor.*

Now that so much interest is being taken in cyanogen as a bye-product of gas manufacture, it may be of service to call attention to an error in the method given in the text-books for determining the amount of ferrocyanide contained in ammoniacal liquor. The error seems to have originated in a communication by Mr. S. Dyson to the Society of Chemical Industry, in 1883, on the examination of ammoniacal liquor, wherein the following directions are given:—

The residue obtained by evaporating 250 c.c. of liquor to dryness is dissolved in water, the solution filtered, and ferric chloride added to the filtrate. The precipitate of prussian blue is filtered off, washed, and decomposed with caustic soda. The ferric hydroxide thus obtained is, after filtering and washing, dissolved in dilute sulphuric acid, reduced, and the solution titrated with centinormal potassium permanganate. The iron (Fe) found × 5·07 equals the equivalent amount of ammonium ferrocyanide (Am_4FeCy_6).

The scheme of analysis is in the main correct; but the factor for interpreting the result is incorrect, and yields a figure too high by 25 per cent. Yet these directions have been copied—apparently without examination—into every subsequent text-book treating of the subject.

It appears to be assumed that the iron precipitated as hydroxide is equivalent to the iron originally present in the ferrocyanide. But this is not the case. Three equivalents of iron, as ferrocyanide, combine with four equivalents of iron, as ferric salt, to form prussian blue; and when the blue is decomposed by an alkali, the ferrocyanide goes again into solution, and the iron precipitated as hydroxide is the equivalent of that taken up from the ferric salt. The two equations are as follows:—

$$\underset{\text{Ammonium ferrocyanide.}}{3\,Am_4FeCy_6} + \underset{\text{Ferric chloride.}}{2\,Fe_2Cl_6} = \underset{\text{Prussian blue.}}{Fe_7Cy_{18}} + \underset{\text{Ammonium chloride.}}{12\,Am\,Cl}$$

$$\underset{\text{Prussian blue.}}{Fe_7Cy_{18}} + \underset{\text{Sodium hydroxide.}}{12\,NaHO} = \underset{\text{Sodium ferrocyanide.}}{3\,Na_4FeCy_6} + \underset{\text{Ferric hydroxide.}}{2\,Fe_2H_6O_6}$$

Thus there are four equivalents of iron in the hydroxide whose value is determined, but only three equivalents in the ferrocyanide whose value it is the object of the analysis to determine; and the factor, instead of being 5·07, should be 3·80.

The following method of estimating sulphocyanide and ferrocyanide, in the same sample of ammoniacal liquor, is submitted as being, for technical purposes, superior to that of evaporating to dryness.

Boil the liquor until ammonia ceases to be liberated; then add sodium carbonate, and continue to boil until all the ammonia has been expelled. Filter off the precipitated sulphur, and add ferrous sulphate to the liquid while still hot. Filter, and wash the precipitate on the filter. The filtrate will now contain the sulphocyanide, and the precipitate the ferrocyanide.

To the filtrate add copper sulphate and a few drops of sulphurous acid solution. Allow to stand until the precipitate of cuprous sulphocyanide comes down. Filter, wash, and dissolve the precipitate in nitric acid. From the nitric acid solution precipitate cupric hydrate with soda. Filter, wash, dry, ignite, and weigh as CuO. Then the weight found × 0·96 = ammonium sulphocyanide (Am SCy).

Boil the precipitate, containing the ferrocyanide, with

* See "JOURNAL," Vol. LVII., p. 692.

soda. Filter and wash. Pour the filtrate *into* a solution of ferric chloride, acidified with hydrochloric acid. Add a little nitric acid, and boil for 20 minutes. The precipitate settles quickly. Filter, and wash until free from ferric salt. Boil the precipitate of prussian blue with soda. Filter, wash, and dissolve the ferric hydroxide in dilute sulphuric acid. Then reprecipitate with ammonia. Filter, wash, dry, ignite, and weigh as Fe_2O_3. The weight found × 2·66 = ammonium ferrocyanide; or × 3·96 = the equivalent of yellow prussiate of potash (K_4FeCy_6 3 Aq.).

Liquid Hydrogen.—Professor Dewar has given the Chemical Society an account of his latest researches with liquid hydrogen. In the "Chemical News," he states that two of the physical constants of this truly extraordinary fluid have now been determined. Its boiling-point in air is −238° C., or 35° of absolute temperature, determined by a platinum resistance thermometer. This value is higher by something like 17 per cent. than that obtained by Olszewski by adiabatic expansion. The whole range of liquid hydrogen is only about 50° from the absolute zero, because its critical point must be about 50° absolute. This value of the boiling-point enables us to predict with almost certainty that by no conceivable means at present at command shall we ever get nearer the absolute zero than − 250° C., or (say) 20° absolute—that is, the practical fall in temperature that liquid hydrogen will give under high exhaustion will never exceed 10° or 15° lower than its known boiling-point. The other physical constant that has been determined is the density of hydrogen. As already described, the substance appears as a transparent fluid, with a well-defined meniscus, and it easily drops from one vessel to another, and may be collected with considerable rapidity. The appearance of the fluid would suggest a density not dissimilar to that of liquid marsh gas, which has a density of 0·41 at its boiling-point in air, and is the least dense liquid known under such conditions. By allowing 10 c.c. of the liquid hydrogen to evaporate, collecting the gas, and measuring its volume, the approximate density can be accurately determined. As a result, the fluid is found to be about 1·14th of the density of water; thus bearing about the same relation to water that hydrogen gas does to air. Liquid hydrogen is in all respects the most extraordinary fluid chemists have ever had to deal with. No chemist could have anticipated that a liquid with a density of 1·14th that of water could be capable of collection and manipulation in vacuum vessels with the same ease, practically, as liquid air was manipulated ten years ago; and that by its aid we shall approach within 20° to 25° of the absolute zero of temperature, which has been apprehended only as a mathematical expression.

How Should Boiler-Heating Surface be Computed?—Mr. C. W. Baker, in a paper which he has presented to the American Society of Mechanical Engineers, criticizes the customary method of calculating the horse power of boilers from the heating surface. He declares that, in computing boiler heating surface, there is commonly an error of from 7 to 17 per cent., due to the practice of taking the surface in contact with the water, instead of that exposed to the fire or hot gases, as the heating surface. If the surface is flat, these areas will of course be the same; but boiler heating surface being mostly made up of tubes, there is a difference between the interior and exterior surface of 17 per cent. in the case of a 1-inch tube, and 7 per cent. with 4-inch tubes. The error arises in the first place from failure to appreciate the fact that the heating surface exposed to the fire is the heating surface of the boiler, on which its steaming capacity depends. The actual difference of temperature between the two sides of a boiler-plate—one side of which is exposed to the furnace and the other to the water—is never more than 1° Fahr. with clean metal. It is Lord Kelvin who has observed that, for all practical purposes, we may consider that the heating surfaces of boilers conduct heat as if they were no thicker than paper, or as if the metal were of infinite conductivity. From this consideration it would seem to follow that, if there is any advantage in copper fire-boxes or brass boiler-tubes, it is not by reason of their superior conductivity for heat. In short, the temperature of boiler heating surfaces is that of the wet side, and not that of the fire side of the plate. This fact is of common knowledge; yet Mr. Baker insists that it has been largely overlooked by most engineers and engineering writers, and that this is one reason why engineers have not always insisted on the fire side of tubes being considered the heating surface of steam-boilers. If this surface is increased, by forming ribs upon it, as in the Serve tube, the heat-absorbing capacity of the tube is thereby increased; but ribs on the wet side would have no such effect. Again, a thin coating of scale on the wet side of the boiler plate or tube does not affect the steaming capacity so much as a furring of soot on the fire side. Another deduction made by Mr. Baker is that the circulation of water in boilers is of much less consequence than is commonly supposed. Good circulation is desirable, so as to prevent unequal heating of the boiler and consequent straining; but it has no effect upon economy or capacity.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 62.)

LAST week brought about a great change in the position of things on the Stock Exchange. We adverted to the probable improvement which might be expected in July; and the improvement set in strongly from the opening day. The advance was most conspicuous in Consols, which had long been languishing; and the rest of the gilt-edged class were not slow to follow suit. The plethora of money gradually forced activity into more speculative channels; so that the week finished showing strength all round. Prices almost everywhere display a more or less considerable advance; and the few exceptions are susceptible of explanation on special grounds. The Bank of England rate was lowered from 3 to 2½ per cent. on Thursday—the higher rate having lasted for four weeks. Money is very cheap; but, cheap as it is, it is likely to be cheaper still this week. Increased supplies will be released, and will come into the market; and a further reduction in the Bank rate is quite on the cards. An improvement was visible in the tone of the Gas Market. Several moderate advances in quotation were effected; and only one retrograde move was made. Business, however, was very quiet all through, until the turn of the half year; and then it roused into activity. In Gaslights, the "A" was torpid until this change set in—marking as low as 290; but on Friday and Saturday, it was brisk and buoyant, and repeatedly marked 294, which was the closing figure. Cheap money made the secured issues unusually active, and sent the 10 per cents up three points, and made a fractional improvement in the debenture. South Metropolitan was lively and full of strength—closing at 144, the best of the week. The debenture also recovered a point. Commercials were hardly noticed. A few transactions took place in the Suburban and Provincial group, with an easier tendency in British. The Continental Companies were almost stagnant—business being of the lightest order; and prices closed unchanged. Union was put down on Wednesday, but was promptly restored the next day. Several of the minor undertakings had a moderate rise, the details of which are shown in the list. Business in the Water Companies was of the usual moderate proportions, and presented no remarkable feature. A large number of issues are quoted *ex div.* this week; and nearly all of them came out the better for it.

The daily operations were: Business in Gas on Monday was extremely quiet; and the only change was a rise of 1 in South Metropolitan debenture. A little more was done on Tuesday; but things still remained quiet below the average, and prices did not vary. Wednesday was another inactive day. Continental Union was lowered 2. On Thursday, there was more animation in many issues; and an improving tendency in prices began to manifest itself. South Metropolitan advanced 2; and Continental Union recovered 2. *Ex div.* changes in both Gas and Water were mainly favourable. Friday was a lively day, especially in Gaslights. The "A" rose 1½; "C," "D," and "E," and "J," 3 each; 4 per cent. debenture, ½; San Paulo, ½; and Ottoman, ¼. But British fell ½. Saturday's prices were very steady, without further change.

ELECTRIC LIGHTING MEMORANDA.

The Introduction of Electric Lighting into the City of London—The City of London Company—Mr. Braithwaite on Competition in Electricity Supply.

IN the current issue of "London" an article appears with the attractive title "How the City Sold its Municipal Birthright," which, being interpreted, means a story of the formation of the City of London Electric Lighting Company. We are not surprised that it has come to this. Our readers are aware that the supply of electric lighting by local authorities on their own account, irrespective of the merits of the case, is a point of the Progressive "program," to the advocacy of which the paper above-named is committed without reserve. In its pursuit of this great cause, "London" has discussed, in the choicest Progressive language, the proceedings of several of the Metropolitan Vestries which happened to be halting between the alternative courses of undertaking electric lighting for themselves and agreeing with private companies for the work. The case of the City was sure to come into controversy sooner or later. Our readers who are able to carry their minds back a few years will remember how long the electric lighting of the City of London hung fire after the preparatory street lighting experiments in the early "eighties." The pages of the "JOURNAL" for years contained occasional references to the difficulty experienced by the Corporation in placing the proposed electric lighting contracts. At that period, anybody who should have proposed for the Corporation to do their own electric lighting would have been laughed at as a dreamer, if not scouted as a "jobber." Electric lighting was regarded as a highly speculative enterprise, as it notoriously was. Not a single Metropolitan Local Authority would touch it. The London County Council, that great and good authority which "London" worships—so long as it has a Progressive majority—has had a small job of electric lighting in

hand from the same period until now, and has done nothing in it. This is the matter of lighting the Embankment.

At least, the Corporation of London succeeded, after a fashion, in procuring a supply of electricity for lighting the City. This was effected by what our perfervid contemporary styles "a very discreditable transaction," in which were "combined the characteristics of Hooleyism and Tammanyism;" thus constituting "one of the worst jobs which tarnish the municipal history of the City of London." We, who have not awakened to-day or yesterday to a knowledge of the manner in which electric lighting has been pushed in some localities, are not disposed to repeat here the record of these proceedings, which we published at the time. The City of London Electric Lighting Company was the outcome of years of negotiation, and now carries on business with a capital of £1,300,000, which must be all expended. The Company until recently charged the highest price, 8d. per unit, and had the biggest revenue—£150,000 a year—of any Metropolitan undertaking. They do an enormous business, and pay an ordinary dividend of 7 per cent. A member of the Common Council, Mr. Brooke-Hitching, thinks the time has come when the City should start electric lighting on its own account; but there is a bar to this in the circumstance that the Company have a 21 years' contract with the Corporation for lighting the streets. The alternative to a competitive service is purchase of the Company's undertaking by the Corporation. It is only just to Mr. Brooke-Hitching to say that, though he is favoured with the patronage of "London" for his electric lighting policy, he has been at pains to dissociate himself from this periodical's attack upon the pioneers of electric lighting in the City. He says, like a wise man, "nothing is gained by going into the past." What he wants is to get the present monopoly bought out. There should be no great difficulty about this, if the Corporation think it worth while to anticipate the ordinary course of events. The electric light is supplied by the City of London Company under the provisions of the Electric Lighting Act; which is to say that there is no "monopoly" about it. There may be—indeed, there is—a contract in existence for the exclusive lighting of the streets by the Company; but what is street lighting worth alone? It is a fact that this same street lighting contract went begging for years, and would be worthless to-morrow if separated from the concurrent statutory privilege of private lighting. By pretending to set so much store by it now, the callow newspaper advocates of "municipalizing" the service are only helping to raise the cost of the operation against the public. Since the above was written, we learn that Sir Joseph Savory, M.P., who was Lord Mayor of London at the time of the inception of the City of London Company, has commenced proceedings for libel against "London" in respect of the attack made upon him for his share in this transaction.

Notice must be taken of the temperately-worded letter of Mr. J. B. Braithwaite, jun., to "The Times" and other newspapers on the subject of the Marylebone and Bermondsey Orders. The writer's firm have acted as brokers to many important electric lighting capital issues; and he draws attention to the gravity of the situation that will be created by the carrying into effect of these Orders. His point is that the capital actually employed by the Metropolitan Electric Lighting Companies was raised on the faith that the local authorities, having had their opportunity of going into the business themselves or supporting a company, would be held to their choice if they once elected for the latter course. "Thus, with the consent of the local authorities in various parts of the Metropolis, electricity supply companies are now engaged in supplying the public; and now that the shareholders have risked their capital, and through their enterprise the industry has been proved to be a profitable one, it would seem unreasonable that the local authority should be allowed to turn round and reverse its former decision, and undertake the supply of electricity itself in competition with the company, whose undertaking it has the right to purchase at the end of a period of years." This is reasonable enough; but, unhappily for the writer's case, there is no getting over the clear language of the Act. If the purchasers of electric lighting shares have ignored the contingency of competition, that is their affair. The proceedings of the Board of Trade in regard to Marylebone and Bermondsey have not created any novel condition; but the circumstances of the cases have served to draw attention to the conditions that previously existed. Hence it is not surprising that financial opinion in "the City" has been veering round to the view that electric lighting shares are not really worth the money that has of late been paid for them. In some instances competition has already done its worst. Where two statutory undertakings are in effective occupation of a district, neither the local authority nor anybody else would be permitted to break up the streets in the interest of a third venture; and with this consolation the proprietors of electric light shares must rest content.

Prizes Offered by the Industrial Society of Mulhouse.—According to the new programme of prizes to be awarded by the above-named Society, a silver medal will be given for a gas-engine of 100-horse power erected in a local factory, and showing advantages over a steam-engine of equal power. The engine must have been at work for at least six months. A silver medal and premium of 500 frs. will be given for a registering pyrometer accurate within 5 per cent. between a range of 300° and 800° C.

THE LESSON OF PHILADELPHIA.

In last week's "Journal" a letter appeared from Mr. R. N. M'Dougall, of the Liberty and Property Defence League, respecting the leasing of the Philadelphia municipal gas-works to a private Company. The purpose of the writer was evidently to advance this most remarkable transaction as evidence of the failure of municipalization in the instance of the gas supply of the third largest city in the United States; and incidentally he observes that the Corporation of Philadelphia paid too much for their labour and coal—the suggestion being that this was done from corrupt motives. His conclusion is that "the Philadelphians seem to have learnt that the most effective way of eliminating corruption is to reduce to a minimum the functions of their Municipality." Never was the customary editorial disclaimer of responsibility for the opinions of correspondents better justified than in regard to this letter. If the Liberty and Property Defence League have set themselves the task of making out a case for the reduction to a minimum of the functions of municipalities, with the object of curing or preventing corruption in this political institution, they are courting discredit and failure. Well may Mr. M'Dougall remark, as it were apologetically, that in England "as yet, there is no disposition to relinquish the municipal supply of gas to private companies, but rather a tendency in the other direction." It does not require one to be a partisan of the idea of municipalizing everything, in order to entertain the feeling that any such "disposition" of a British Municipality as that indicated by Mr. M'Dougall would be a sign of decadence to be heavily deplored. The attempt to cite the example of Philadelphia as something analogous to the case of British Municipalities, in respect of gas supply, is an insult to the latter. We can say this without fearing to anger a single honest American citizen who may read this article. For reasons which need not be gone into here, it has come to pass that a United States Municipality is usually—in the larger cities almost invariably—a thing apart from the community. What it does or neglects to do is no concern of the people, except that they have to pay for it. It is unnecessary to say anything here concerning the relations commonly subsisting between British Local Authorities and the communities they represent. Suffice it to observe that there is no similarity whatever, except in name, between a British Municipal Corporation and a United States Municipality. Our Municipal Corporations are not impeccable, and they have a history which is far from creditable in all respects. It may be pointed out, however, that the period of their history when these institutions were most corrupt and inefficient was precisely that in which they had the least amount of work to do, and were organized on the most restricted bases.

The Local Authorities of Great Britain for many years past have manifested a growing desire to undertake local public services, of which gas supply is one. During the last year or two, this particular movement has gained strength. So strong has it become, indeed—and this under the guidance and by the inspiration of some of the most prominent leaders of the industry concerned—that any gas company not already safeguarded by legislation of the most modern type can hardly go to Parliament nowadays for fresh powers without being compelled to sell the property to the local authority. How is it, then, that the experience of Philadelphia, even taken with all its qualifications and explanations, should point to such a contrary solution of the problem of economical gas supply as being proper for the United States? Is it a step forward, or a falling back in obedience to a counsel of despair? In other words, are British Municipalities actually on their way to realizing the experience of Philadelphia; or is the latter a failure—perhaps temporary, perhaps permanent—to live up to the standard of municipal probity and efficiency that obtains here and elsewhere?

Mr. M'Dougall quotes from an essay by Dr. Rowe, of the Pennsylvania University. For the benefit of our readers we may say that Dr. Rowe's essay forms No. 229 of the publications of the American Academy of Political and Social Science. Dr. Rowe is described as Assistant Professor of Municipal Government at the University of Pennsylvania. How backward we are in this country in such matters as University "Chairs"! In the United States, the subject of Municipal Government is "professed" at the University of Philadelphia, and possibly at other State Universities. What a pity it is that the practice of the thing should be so defective in the same localities! This fact goes to discredit the whole modern scheme of technical education that one hears so much about at home and abroad. We have had Dr. Rowe's essay on "The Municipality and the Gas Supply, as Illustrated by the Experience of Philadelphia," before us for a week or two; and its mention by Mr. M'Dougall reinforces our original intention of discussing it as a contribution to the literature of an interesting and important branch of gas-supply politics. The same matter is dealt with by Professor Edward W. Bemis in the March number of the "Forum;" but we will take Dr. Rowe first.

This competent critic declares justly that "the recent decision of the Mayor and Council of Philadelphia to lease the gas-works to a private Company marks a change of policy of more than local importance. That the third largest city in the United States should decide to relinquish the control of one of its public works, after forty years of *quasi*-municipal management

and some ten years of complete municipal ownership and operation, will naturally be construed as a confession of the inability of public authorities to administer public works successfully, or at least as an acknowledgment of the superiority of private over public management." This is, in fact, Mr. M'Dougal's use of the example. Of the facts of the particular instance, there is no question. The friends as well as the opponents of the Philadelphia Gas-Works lease were generally agreed that the results of municipal management were not encouraging. It appears to be Dr. Rowe's view that the facts, such as they were, did not warrant the particular remedy jumped at by the people of Philadelphia, and still less justify the general conclusion already enunciated. So far as Philadelphia was concerned, the people wanted cheap and good gas, which their Municipality had failed to provide. The private Company came along with an offer full of immediate advantages. The average citzen thought he had no time or skill to consider the question of leasing the gas-works on other grounds than the shortcomings of the management; and the transaction was hurried through before the public could awake to the magnitude of the ulterior interests involved. Within a week of the signing of the lease, the public had forgotten all about it.

As Dr. Rowe tells the story, the history of the gas supply of Philadelphia is of the essence of the question whether the period of municipal management was really characterized by failure. When the gas-works were started, in 1835, the undertaking was in the form of a combination of public and private ownership and management. In 1841, the City became sole owner; but the management of the property was entrusted to a Board of Trustees elected by the City Councils, and known as the Gas Trust. This body seems to have been analogous to the Scotch Gas Commissions; but its operations were characterized by shameless corruption, fraud, and mismanagement, for which a parallel would elsewhere be sought in vain. "During the closing years of this irresponsible body, especially between 1875 and 1885, the plant was permitted to deteriorate, improved methods of production were ignored, mains and service-pipes were allowed to rust and rot, and no attempt was made to adapt the plan of distribution to the increase in production and consumption. The works had gradually become filled and overfilled with the political subordinates and henchmen of the Board. It was shown by the attorneys of the Committee of One Hundred—a body which aided the City in the prosecution of the Trustees—that the superficial area of the property of the works was not sufficient to accommodate those on the pay-rolls, even when placed shoulder to shoulder." The City, it appears, came into possession of this condemned heritage in 1887, when the Bureau of Gas was organized as a part of the Department of Public Works, and placed under the control of an official directly responsible to, and removable by, the Mayor. Dr. Rowe maintains that the new arrangement worked reasonably well, having regard to the circumstances. Thus, in 1870 the charge for salaries and wages in gas manufacture was nearly 3s. 2d. per 1000 cubic feet of gas made; and this was reduced to 11d. in 1896. But the weaknesses characteristic of United States municipal management remain. The City Council continued to direct the financial and other operations of the Bureau of Gas, with disastrous results.

Let Municipalities everywhere take notice. The evil of using the gas-works as a political engine, though a most serious obstacle to efficiency, was, in Dr. Rowe's opinion, a small trouble compared with the short-sighted financial policy of the City Councils. Council after Council appropriated the gross profits of the gas undertaking to relieve the rates, regardless of the needs of the works. "Between 1887 and 1897, nearly $8,000,000 would have been available for the improvement of the plant. Hardly a sixth was used for this purpose. Year after year, the Director of Public Works urged upon Councils the necessity of improved methods of production and distribution. With equal regularity, Councils continued to use the profits from gas making to defray general city expenses." Consequently, the manufacturing and distributing plant grew obsolete, and costly in operation. "The former showed an unusually high cost of production; the latter an inordinately high percentage of leakage." It cost nearly 2s. per 1000 cubic feet to put gas into the holders. Hence it was easy for private companies to offer to supply the city with gas at a cheaper rate. The opportunity was seized by a private Company, who offered to furnish the Gas Bureau with an auxiliary supply of carburetted water gas for 37c. per 1000 cubic feet. The Bureau imagined they were doing a good stroke of business by accepting this offer, especially as they could not get the money required for extensions of their own plant. But the result was that the City became more and more dependent upon the accessory undertakers, until the psychological moment came for the latter to "scoop Philadelphia in." And not before it was time; for the unaccounted-for gas had in 1896 risen to nearly 25 per cent.

Everything else was as bad. Though the worst of the abuse of over-payment of salaries and wages was being cured, much still remained to be remedied. In the first place, the City had a fixed rate of wages far above the market rate for similar labour. The Director of Public Works published a statement declaring that instead of paying the 1700 labourers $1·75 per day, he could get equally competent men for $1·25 per day. This is all recounted by Mr. M'Dougall. Dr. Rowe's pungent comment upon the statement is that, "whatever may be said in favour of 'trade union wages' in city employment, it must be remembered that this excess of 50c. per day above the market rate involved an additional annual outlay of nearly $275,000." There were other drains upon the resources of the Department. For some reason, the tenders of the firms offering coals at the lowest prices were invariably ignored. With regard to the returns from residuals, also, it was ascertained that certain persons had the monopoly of purchasing these products at less than the market rates. From all this Dr. Rowe argues that "the most serious defects connected with city management are traceable to evils inherited from a period which cannot give us a fair test of municipal efficiency. During the decade of responsible city control, we find abundant indication of improvement in every direction. That such improvement has not been more rapid is to be attributed to the short-sighted policy of Councils rather than to defects in the administration of the Gas Department."

In view of the importance of what Mr. M'Dougall calls this "Object-Lesson in Municipal Gas Supply," we shall defer the conclusion of this article to another issue of the "JOURNAL."

THE SUPPLY OF ELECTRICITY IN BULK.

THE report of the Joint Select Committee of the House of Lords and House of Commons on Electrical Energy (Generating Stations and Supply), with the Proceedings of the Committee, has now been issued as a Parliamentary Paper. It should be filed for reference by all those who are interested in the extremely important matters of which it treats, which are by no means restricted to the electrical industry. The subject of the report has been discussed in our "Electric Lighting Memoranda," and we engaged when mentioning it last to return to it again. The present article is the fulfilment of this engagement. It is unnecessary to repeat the information respecting the terms of the reference to the Committee, which were given in the "JOURNAL" for May 31. The report, however, the text of which will be found in another column, sets out in form the questions put to the Committee, and gives their answers, of which only the general purport was known at that date.

The questions themselves appear to be simple enough in the main, and to fall into two categories—as to whether powers for compulsorily acquiring land for central stations should be given to undertakers of electricity supply, and as to whether powers should be granted for the supply of electricity in bulk over large areas. Behind these questions lay the consideration that upon the tenour of the Committee's answers to them depended the immediate future of a proposed new development of the electricity supply industry. The questions concerning the compulsory purchase of land for generating stations admitted of direct answers, of which there was no possibility of consequential development. There is nothing in the facility in question contrary to the spirit of the Electric Lighting Acts, or otherwise than in harmony with the general character of statutory electricity supply enterprise dealt with by those Acts. Consequently, the Committee, recognizing the fact that electricity supply from central stations has passed the experimental stage, and is of advantage to the public, have agreed that undertakers of such supplies, whether local authorities or companies, should have "compulsory powers for acquiring sites for generating stations, and lands or easements for pipes and mains therefrom, and other works." This is one point. The next is the declaration that, in the opinion of the Committee, "provision should be made for the granting of these powers in the Provisional Orders of the Board of Trade, subject to confirmation by Parliament."

Let us pause here in order to draw our readers attention to the circumstance that, if this recommendation is acted upon, the Board of Trade will be in a position to grant greater facilities to undertakers of electricity supply than the same Department, or the Local Government Board, can bestow upon undertakers of gas or water supply. We do not begrudge the electricians or the Board of Trade these superior advantages, but only venture to suggest that a similar privilege should be extended to applicants for Provisional Orders under the Gas and Water Works Facilities Act.

With regard to the liability of undertakers of electricity supply to proceedings for nuisance, the Committee are of opinion that where the site for a generating station is acquired under compulsory powers, and is specified in the Provisional Order or Special Act, "the undertakers should not be subjected to any further liability than that which, according to Lord Blackburn (*Geddis v. Bann Reservoir*, 3 App. Cases, 455), is imposed by common law in the case of persons exercising statutory powers and duties." The opinion of Lord Blackburn is repeated as follows: "It is now thoroughly well established that no action will lie for doing that which the Legislature has authorized, if it be done without negligence, although it does occasion damage to anyone. But an action does lie for doing that which the Legislature has authorized, if it be done negligently. And I think that if, by a reasonable exercise of the powers either given by statute to the promoters or which they have at common law, the damage could be prevented, it is, within this rule, negligence not to make such reasonable use of their powers." Those who

are accustomed to advise gas and water companies upon such matters know that the so-called monopoly, or statutory guarantee of gas and water supply undertakers against competition, depends upon nothing more substantial than this principle. It is no nuisance for a statutory gas company to break open the public roads for the purpose of laying mains, or of attending to them when laid, provided that the work is properly done. It is a nuisance for another party to do the same thing, without statutory powers. In regard to recent prosecutions of gas companies for creating nuisances of other kinds, it might be argued that the principle enunciated by Lord Blackburn was not adequately exercised by the defence.

In respect of the questions put to the Committee regarding the expediency of granting powers "for the supply of electrical energy over an area including districts of numerous local authorities, and involving plant of exceptional dimensions and high voltage," the ulterior effect of the answers is of serious import. Here we come to a development of electricity generation and supply which was not contemplated when the existing Electric Lighting Acts were passed, and is, in point of fact, incompatible with some of the leading provisions of these Acts. The most serious of the discrepancies between the law and the proposed practice arises in respect of the intention of the former to make the supply of electricity a perquisite of the local authority. This motive was based upon the presumption that there was nothing in electricity generation or supply which the local authority could not do; but, as the Committee find, the presumption does not hold good of the new development under notice. The Committee had to decide whether the principle of the existing Acts should prevail, or the new development be encouraged. They chose the latter alternative; deciding that undertakings of the new order "may properly be authorized on conditions differing in some respects from those imposed by and under the existing Acts." This notable declaration throws open the electrical industry to a wider future than was possible for it under the cramping condition of paramount municipalism.

In arriving at this decision, the Committee were helped by the several Bills now pending in Parliament which propose to give effect to new developments of the electrical industry. We report elsewhere the proceedings of Parliament with respect to one of these Bills. Obviously, the privilege of municipalism (which was the burden of the electric lighting legislation of the past decade) must go if these large schemes are to be carried out. The Committee are conscious of the gravity of the position created by the introduction of projects of this kind; but they decline to put a bar to electrical progress in the interest either of municipalism or of conformity with the existing law. It is declared, however, that every instance of the kind should be dealt with strictly upon its merits, whether as regards grant of powers, exemption from liability to purchase by a particular local authority, or any other consideration.

As an alternative to liability to compulsory purchase, the Committee suggest that "it would be specially expedient, in the interest of the consumers, that some kind of sliding-scale, as in the case of gas undertakings, should be imposed. This is a most remarkable observation, not only on the score of its being so strong a testimonial to the high opinion of the sliding-scale principle entertained by the Committee, but even more by reason of the place assigned to the principle as an equivalent alternative to purchase by the local authority. It appears almost impossible to overrate the significance of this passage of the report. In the draft report proposed by the Chairman (Viscount Cross), after the specific questions had been answered, there appeared a paragraph which ran as follows: "We consider that the time has now come when electric lighting undertakers should be subjected to provisions enforcing a sliding-scale similar to that which obtains in the case of gas companies." The amended form of the paragraph, however, was adopted by a majority. A motion to apply the auction clauses to electricity supply companies was rejected.

The only other passage of the report to which we need specially draw our readers' attention is the last paragraph but one, which is as follows: "The clauses [in Provisional Orders] which protect gas and water pipes have worked satisfactorily, and should be contined; but the Committee would direct attention to the observations of Mr. Preece as regards the difficulty arising from the working of tramways by trolley wires. His suggestion as to a strong 'control clause' should be carefully considered."

The report, as a whole, is a weighty pronouncement in favour of freeing the electrical industries from unnecessary restrictions, and granting them facilities for all legitimate natural development. It remains to be seen how the grand schemes for generating and distributing electricity in bulk, supposing them to take form and substance, will affect the gas business in the localities chosen for exploitation in this way, and also the local authorities having Electric Lighting Provisional Orders. Electrical power, distributed at the same price as gas power, will perhaps check in some degree the demand for gas-engines. The question of how and to what extent the same supply will operate upon municipal electric lighting is more abstruse. From certain considerations, it may be expected to prove a means for introducing electric lighting where it would otherwise not be available. The municipalities likely to be most affected by the new departure, however, will be those contemplating extensive schemes of electricity generation for tramway working. Throughout all the different industrial regions to which the generic name of the Black Country is popularly applied, there are continuous lines of tramway which a quick electrical service would vastly improve. Different municipalities have had their eyes upon this improvement, which it has been thought would turn in handsome profits to the municipal treasury. In the case of Manchester, for instance, a Corporation monopoly of electricity supply might conceivably redress the balance of the Ship Canal, not to say anything about the pending main drainage business. Hence it is easy to understand why Manchester should strenuously oppose any company proposing to generate electricity cheaply just outside the city limits, and transmit it in bulk throughout the district.

English municipal law and practice has never favoured the idea of local authorities undertaking any public service being dependent upon outsiders for the supply of the necessary article, whatever it may be. True, such authorities buy both gas and water in bulk, and undertake to distribute these necessaries; but in the case of the former there are not many perfectly satisfactory permanent arrangements of the kind in force. It may be taken that a local authority would have to show to the Board of Trade very good and sufficient reasons for carrying out an Electric Lighting Order by means of current purchased in bulk from a company, or for relying upon such a source of supply as an auxiliary, in preference to extending the local works. Meanwhile, interest shifts from the general to the particular, as exemplified in the cases of the new electricity supply companies whose Bills will be adjudicated upon by Parliament in the light of this report.

PERSONAL.

Mr. J. A. Carter, of Ennis, has been appointed Gas Manager at Castlebar, where the gas-works have been entirely renovated, and a new holder erected.

Mr. William Owen, late Manager of the Horley District and Twyford Gas Companies, has secured the appointment of Manager of the Hatfield Gas Company.

Mr. Frederick Key, of Darenth, Kent, has been appointed Gas and Water Manager to the Birstall District Council, in succession to the late Mr. John Graham. The vacancy was advertised in the "Journal" for the 14th ult.

Mr. Charles Potts has been appointed Manager and Secretary to the Hyde Gas Company, in succession to the late Mr. W. Smith. Mr. Potts has for some time filled the position of Chief Clerk; and he has been connected with the undertaking for over thirty years.

Mr. Charles Lawler, J.P., has been selected by his colleagues on the Board of the Alliance and Dublin Consumers' Gas Company to succeed the late Mr. Edward Fottrell in the chairmanship. Mr. Lawler has for several years been a most active member of the Board, and is intimately acquainted with the Company's business in all its departments.

Mr. Hubert Russell, son of Mr. F. Russell, Engineer and Manager of the Bexhill Water and Gas Company, has been appointed Secretary and Manager of the Holmfirth Gas Company, in succession to Mr. S. Crossland. Applications for the position vacated by Mr. Crossland, who goes to Abingdon, were invited in the "Journal" for the 14th ult.

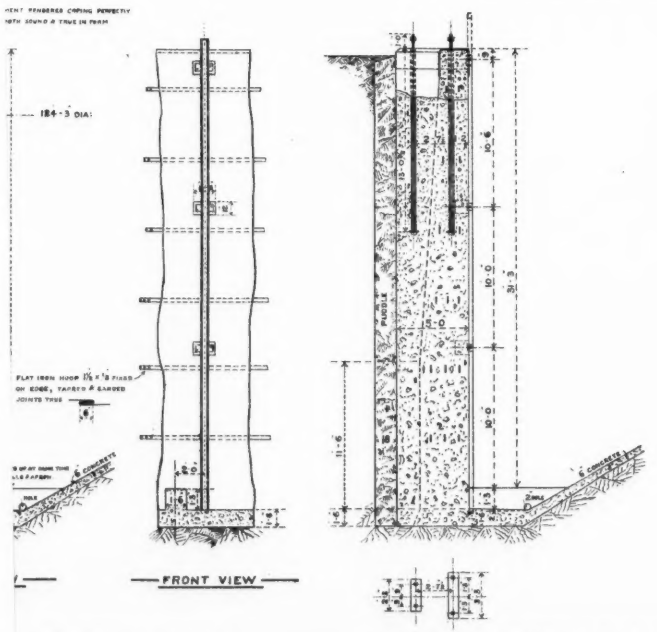
Much sympathy has been expressed with Mr. Gordon Walker, the Engineer and Manager of the Wantage Gas-Works, on the death of his wife, which took place last Tuesday evening. Mrs. Walker had been unwell for the previous fortnight; but yesterday week she was suddenly taken worse, and rapidly declined. The cause of death was internal inflammation, pneumonia, and failure of the heart's action. Mrs. Walker leaves a family of five young children; and deep sympathy is felt for them and for Mr. Walker in his great trial.

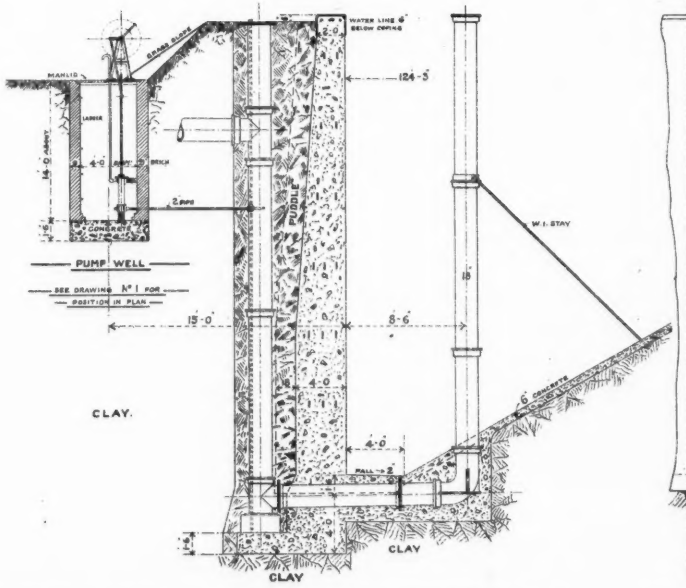
On the 9th ult., at Ceará, North Brazil, Mr. Thomas M'Making, Engineer and Manager of the Ceará Gas Company, Limited, was presented, on behalf of the staff and employees of the Company, by Mr. John Reid, the newly-appointed Engineer and Manager, with a case containing a silver inkstand, &c. Mrs. M'Making was on the same occasion the recipient of a silver egg-cruet. Mr. M'Making has been for the past twelve years Engineer and Manager of the Company, and was highly respected by the staff and employees. Mr. Reid served his apprenticeship with Mr. Sharman, at Wisbech, and has been eight years with Mr. M'Making in Ceará. After the presentation, a very pleasant evening was spent.

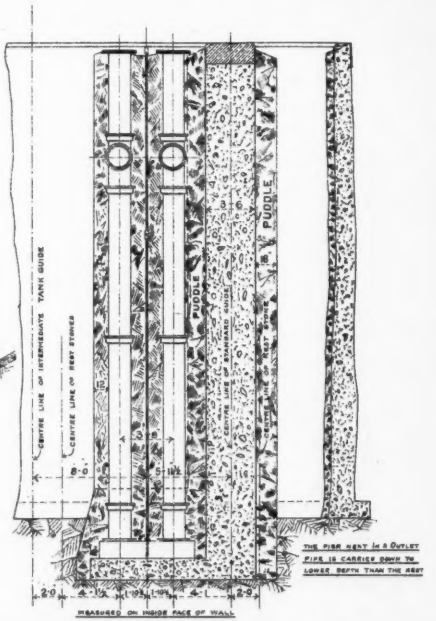
A Long Jointed Steel Water-Main.—The new steel main now being laid for the water-works of Adelaide, South Australia, is of interest, from the fact that, though riveted pipe was originally specified, the authorities found a joint suggested as a substitute so satisfactory that they adopted it. The pipe is 8¾ miles long; and the pipes used are 15 to 26 inches in diameter. The pipes are formed in 26-feet lengths, and are made up of two ¼-inch plates and two locking-bars serving to connect them. The plates are slightly dovetailed at their edges, and the dovetails fit into grooves in the locking-bars; the sides of the grooves being finally closed down on the plate by hydraulic pressure. The joints are stated to be perfectly tight, and to be cheaper than riveted ones.

ASHOLDER TANK — SUTTON GAS-WORKS — N° 7.

DETAILS SHOWING WALLS, PIERS, HOOP IRONS, IRONWORK TO BE BUILT IN, &c



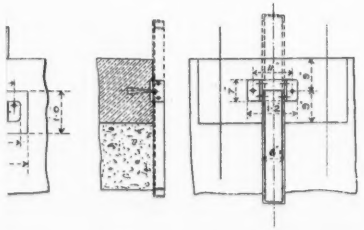




N OF TANK GUIDES — SECTIONAL ELEVATION & PLAN OF HOLDING DOWN BOLTS & PLATES, ALSO GUIDES OPPOSITE STANDARDS — ELEVATION OF INLET & OUTLET PIPES — BACK ELEVATION OF INLET & OUTLET PIPES

HAIRS AND BRACKETS FOR SAME — SEE DETAILS BELOW

INERAL SCALE — SCALE FOR DETAILS

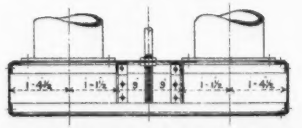


UIDES — STANDARD TANK GUIDE

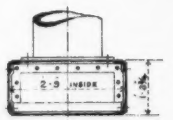
NOTE!

ALL IRONWORK SHEWN ON THE DRAWING EXCEPT HOLDING DOWN BOLTS & PLATES TO BE FIXED BY THE CONTRACTOR FOR THE GASHOLDER BUT ALL BUILDERS WORK IN CONNECTION THEREWITH TO BE DONE BY CONTRACTOR FOR TANK

CAST IRON FLANGE

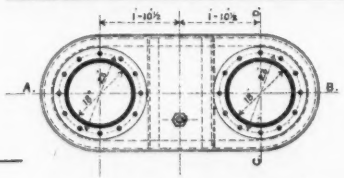


SECTIONAL ELEVATION OF SYPHON BOX AT A.B.



SECTION AT C.D.

WROT IRON FLANGE



PLAN OF SYPHON BOX

F. B. CRIPPS, A.M.I.C.E. ENGINEER. (27 GREAT GEORGE ST. WESTMINSTER)

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COMMUNICATED ARTICLES.

THE GASHOLDER TANK AT SUTTON.

By F. S. Cripps, Assoc.M.Inst.C.E.

Drawing No. 6 (given last week) is the general drawing for the tank; and Drawing No. 7, appearing to-day, is that of the details, showing the ironwork to be built in or partly fixed by the contractor for the tank.

Embankment.—To reduce the depth and amount of excavation, and so save not only its cost, but also the cost of carting away the material, the tank was designed to stand 5 feet above the level of the ordinary ground-line of the works. The tank is banked up all round to this extra height; thus saving still more of the excavated material, including all the top soil.

Foundations.—It will be seen from the drawings that the wall of the tank rests upon a foundation of natural clay, which has first been cut, watered, turned, trodden, and punned into a plastic and water-tight mass. The cone or dumpling was similarly treated; the coating of concrete being simply to preserve it in true form, and to make a firm foothold for the men when erecting the gasholder. The concrete cover to the cone thrusts hard against the toe of the apron at the bottom, and is thickened up somewhat as it approaches it. The steepest angle at which the clay is found to stand safely is 30°.

Concrete Wall.—The thickness of the wall at the foot is 4 feet, which is about 6 inches thicker than it might have been if ordinary Thames ballast had been used. This extra thickness was allowed in case the burnt-ballast should not prove as good a material as expected.

To assist in binding the wall together, and preserving it in true form, hoops of 1½ inch by ⅛ inch flat iron (tarred and sanded) were laid in the wall at intervals of about 5 feet in the height, as shown on Drawing No. 7.

The clay was burnt into ballast as it came from the trench. It required no breaking up, but cracked of its own accord (in the burning) into pieces which would pass through a ring about 2 inches or 2½ inches diameter or less. No sand whatever was used—only burnt-ballast and cement in the proportions of 6 to 1. It was found that the ballast was very thirsty; and therefore it was kept well watered in the heap before mixing.

In making concrete of this kind, it should be noted that it is most important that the clay shall be thoroughly well burnt. It can be done with coke breeze, or partly breeze and partly coal; but coal dust is perhaps the most satisfactory fuel. After first starting a comparatively small heap over a wood fire with air inlets below, the clay and coal are piled up in a mound in alternate layers—*i.e.*, a thick layer of clay followed by a mere sprinkling of coal dust. When the heap has attained considerable dimensions (about 15 feet in height), it is fed so that the burnt ballast may be taken from one side while the clay is burning on the other—the mound growing in one direction only. It must not be used hot, but must be thoroughly cooled and saturated with water. Some experience is required in knowing when to feed the heap with coal and clay, so that it shall be properly burnt and without waste of fuel.

The concrete did not set quite so quickly as when made with ordinary ballast; but it is now "like a rock." The face is also somewhat rougher, probably due to the absence of sand.

The concrete was shot down vertical shoots at intervals of about 12 feet round the circle, and immediately spread to form the wall. In doing this, care was taken not to throw it violently. It was lifted with the spade and deposited in position, in bulk as much as possible, or pushed into place. The whole circle was brought up regularly—that is, no part gaining more than 3 feet in height on another. Every 3 feet stage was made good for the entire circle before proceeding with the next. Each layer was keyed with the one above, by leaving blocks of timber in so as to form a chase or V groove round the circle. They were then extracted before putting in the next layer of concrete.

Excavation and Timbering.—The excavation was carried out as follows: After removing the top soil down to the clay and the whole surface had been levelled right across, a central pier of concrete was put in, having its foundations somewhat below the top of the dumpling. Into this was fixed the iron centre pin for the trammel. The inside and outside circles of the trench were then trammelled out, and the excavation of the trench was commenced.

The width of the trench in the clear was 8 feet for the full depth; the outer circle being 18 inches clear of the wall at the base (*i.e.*, equal to the thickness of the puddle backing), and perfectly upright back and front.

No provision was made for the fourteen piers under the standards. The ground for these was excavated 3 feet at a time—that is, as each frame of timber was withdrawn, the clay was dug out behind to a sufficient width for the puddle behind the piers; the timbering on the outer circle of the trench was, therefore, a complete circle and of the simplest character. It was in 3 feet stages or frames in both circles.

Forming Wall and Shuttering.—After making the clay bottom of the trench into a plastic and water-tight condition, the puddle was put in at the back, and the apron concreted in right across. Then, instead of using timber shuttering for the back of the concrete wall, the clay puddle was made to do the duty of shuttering.

The front face of the wall, however—as it was required to be perfectly true in form—demanded very careful moulding. Twenty-eight strong timber uprights, to act as guides for the shutters, were rigidly fixed (and strutted from the side of the trench) at equal distances apart round the circle. The faces of these posts were planed, and were perfectly erect, and fixed so as to be flush with the inside face of the wall. Sufficient moulding shutters were then made, 3 feet deep, of the correct sweep, and extending from one post to the next all round the tank. These were quite free, and were simply wedged up flush with the face from fillets fixed on the sides of the timber uprights or guide posts. The shutters were struck as soon as the 3 feet ring of concrete had sufficiently set. They were then raised another 3 feet, and so on, for the whole height of the wall.

As before stated, the back of the wall was formed by putting the puddle in first to the required thickness (after withdrawing the 3 feet of timber framing), and then filling in the concrete between the puddle behind and the wood shutter in front.

Puddle.—All puddle was mixed in a pug-mill and was *thrown* into position from the top of the trench. It was then punned, and trimmed to the true circle before filling in the concrete. To keep the top face of the last layer of concrete clean, it was covered with sacking before raising the puddle backing.

The undercutting for the puddle behind the piers was easily accomplished as the wall rose. The pier itself was 6 inches in advance of the timbering, so that there was no difficulty in throwing the puddle in and making it sound behind the pier, because as each tier of timbering was removed, and the clay cut back, the puddle below was well trodden and made good.

Inlet and Outlet Pipes.—The excavation, &c., for the inlet and outlet pipes, being kept snug against the tank wall and in the corner next a pier, did not necessitate much extra work. It will be observed that they are embedded in concrete where they pass under the wall and enter the inner circle of the tank; and they are thoroughly surrounded by puddle on the outside for the full height.

Tank Guide Stones.—The stones for the tank-guides were laid in position as the wall was brought up, in the usual way.

Holding-Down Bolts.—The holding-down bolts were fixed quite loose; a short wood box being placed round each when filling in the concrete; and this, being tapered, was easily raised higher and higher as the pier was brought up in 3-feet stages.

Rest Blocks.—The twenty-eight rest blocks upon which the gasholder lands, were formed in concrete and set perfectly true and level.

Standard Stones.—Stones are fixed under the standards in the usual way.

Coping.—The coping was made in rough concrete blocks; and after fixing in position it was rendered perfectly smooth on the exposed faces. A 3-inch overflow is provided, 6 inches below the top of the coping, and a 3-inch pipe for filling the tank with water. These are both cast in the coping blocks.

Pump-Well.—The pump-well already alluded to in the description of the gasholder is watertight; and an iron ladder is fixed so that there is convenient access to the pump at any time.

Finishing-up.—In order to give the whole structure a good appearance, it will be surrounded by a hard burnt-ballast path, having a clinker border, and the embankment trimmed up and turfed to a true form. The gasholder itself is painted light red; the guide-framing, roller carriages, and hand-railing white.

The contractors for the gasholder tank were Messrs. B. Cooke and Co., of London; and those for the holder, Messrs. C. & W. Walker, of Donnington. The gasholder was erected by the well-known gasholder erector Mr. John Monk; and it is gratifying to be able to record that the whole of the work, both on the tank and holder, has so far been executed without any accident.

PHOTOMETRIC STANDARDS.

By W. Grafton, F.C.S., of Beckton.

(*Continued from* Vol. LXXI., *p.* 1574.)

Analysis of Flame.

The standard was now carefully set at one end of a 60-inch open bar with a carriage, carrying a disc-box and a Methven standard working thereon. The disc and screen were 15⅝ inches apart. The Methven screen was supplied with pentanized coal gas; the carburetter being in a bath of water at 60° Fahr. The results were calculated by squaring the distances. To the Dibdin standard was attached an appliance to allow light from 5 mm. sections of flame to pass through. Analyses of five flames were made. Diagrams B, C, D, E, and F (p. 48) represent the average results of the experiments.

In these we see a falling off in light value of the 2·15-inch portion as the flame is more or less than 3 inches, and also that the light of each flame varies most above and below (40 and 20 mm.) the zone of maximum intensity. From 25 to 40 mm. the light is practically constant for all flames experimented upon. Referring to these results, they tell us that, to make the Dibdin standard right, we must reduce the aperture by 3½ mm. Comparing the reduced standard and a Methven screen in a Letheby

DIAGRAM B.

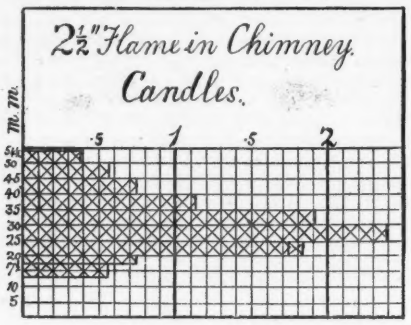


DIAGRAM C.

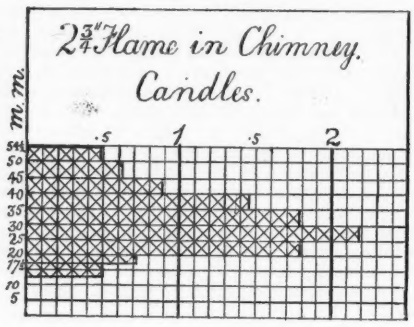


DIAGRAM D.

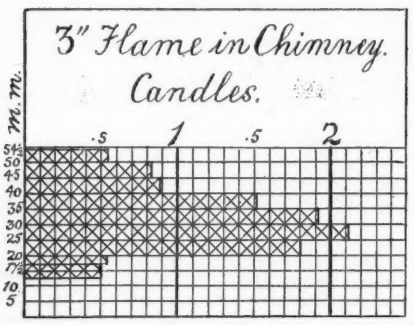


DIAGRAM E.

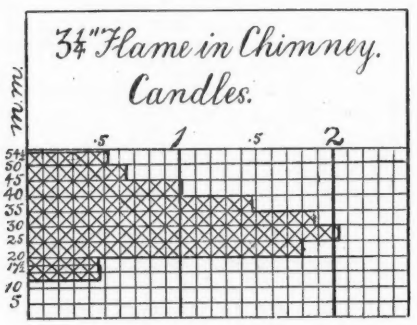
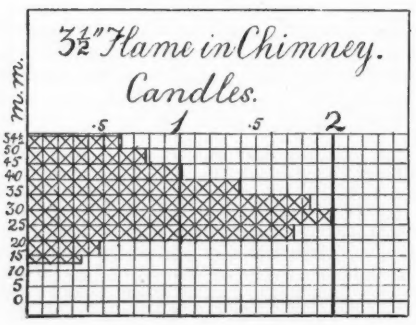


DIAGRAM F.



photometer, the Dibdin standard is equal to 10·012 candles; and this agrees with candles.

Analyses of Dibdin flames at temperatures of (the room) 57° and 82° were made, taking ¼-inch sections of the standard flame. The percentage of light from steatite is as follows:—

At 57°.		At 82°.		Sections. Inch.
3·47 p. ct.		4·66 p. ct.		0 to ¾
11·63 „		16·10 „		¾ „ 1
25·13 „	Power of standard, 10·7 candles.	26·44 „	Power of standard, 9·4 candles.	1 „ 1¼
22·97 „		20·72 „		1¼ „ 1½
16·84 „		17·16 „		1½ „ 1¾
10·75 „		11·49 „		1¾ „ 2
9·17 „		3·41 „		2 „ 2·15
99·96		99·98		

The Dibdin standard is greatly altered by an increased or a decreased temperature, apart from pentane vapour. This result is not only found to attach itself to the Dibdin flame, but similar conditions affect the candle, and, in fact, all flames. No matter what flame is chosen as the standard, it will be subject more or less to the influence of temperature. It is not the increased heat that makes a change in the power of the standard so much as the accompanying increase of moisture and often carbon dioxide. The pentane flame is more sensitive to the influence of moisture than a coal-gas flame. A few experiments were made with the 3-inch pentane flame supplied with air at different temperatures, and the light found is expressed in percentages in the following table:—

TABLE VII.—*Effect of Moisture on the Dibdin Flame.*

Temperature of Room, 60° Fahr.; Bar., 30·53; Feb. 10, 1896.

Ordinary Air. Natural Supply. Light per Cent.	Dried Air. Natural Supply. Light per Cent.	Saturated Air. Natural Supply. Light per Cent.	Humidity of Ordinary Air. Per Cent.
100	106·12	96·58	67

Apparatus Placed in a Path at 80° Fahr.

100	107·15	87·60	not taken.

Temperature of Room, 74° Fahr.; Bar., 29·85; June 17, 1896.

100	105·83	93·99	71

The air was dried by passing that used for combustion over concentrated sulphuric acid; and the small quantity used to carry the pentane vapour, by calcic chloride. By substituting clean water for the acid, the air was saturated by passing it over the water in the vicinity of the burner.

Mr. Methven found that the "London" argand, when supplied with saturated air, suffered a loss of 10 per cent. of light value by increasing the temperature 25°. The writer finds that the pentane 3-inch flame suffers a loss of 12·4 per cent. of light value for only 20°. But the most remarkable feature of these experiments is that, by saturating the air at 60° and 74°, there was a loss of 3·42 and 6 per cent. of light; while by drying all the air used at the same temperatures, a gain of 6·12 and 6·83 per cent. of light was found respectively. The degree of saturation may vary between 4·9 and 12·4 grains of moisture per cubic foot of air; but, in practice, inside a room it is found by the wet and dry thermometers to vary at least between 2·7 and 7·1 grains of moisture. These figures then show that the Dibdin standard is subject to at least a variation equal to the action produced by 4·4 grains of aqueous vapour. These results prove that it will be necessary to correct for moisture, if the standard recommended is composed of so large a flame. This, however, would not be necessary if a small portion of the flame be taken to form the standard as is the case with the Methven, since the zone of intensity is least affected.

The experiments with carbon dioxide were not determinate, being much more difficult to carry out; but they indicate a very large reduction, and show that the loss of light is greater; and not a multiple for each 1 per cent. added to the air.

Two Dibdin standards were compared in a Letheby photometer—one supplied with pentanized air, and the other successively with gas only, pentanized gas, and pentanized air. All gases were pentanized in the carburetter attached to the burner, and the latter was detached when supplied with *coal gas only*. The following harmonious results were obtained with a temperature of 61° Fahr., and the barometer at 30·95, from Jan. 15 to 31, 1896:—

Coal Gas Only.	Rate Corrected. Cubic Feet.	True Quality of Gas Used.	Pentanized Gas.	Pentanized Air.
10·942*	4·19	16·92	10·08*	10·10*

These experiments show that, at the temperature employed, there is but little difference whether air or gas is used as the carrier of the pentane. They show also that, if the flame be made up of only coal gas, the power of the standard is augmented by 8·4 per cent. When comparing the standards in this way, great care is necessary to see that the carburetters are equally filled with pentane, and that the burners have been burning half an hour, in order to equalize the temperature of the carburetters. Some time must be allowed when changing from gas to air and *vice versâ*.

Both standards were fed with air from the same holder, the flames adjusted to 3 inches, and observations made. In changing the position of the standards, no taps were touched; the burners were simply lifted off each carburetter, and put on the carburetters in the reverse ends of the photometer—*i.e.*, A burner on B carburetter, B burner on A carburetter—the terminals of the photometer coinciding with the centre of burner. In this way—with these particular standards—the flames required no

* These results are not corrected for the high power of the Dibdin standard.

adjustment, but were allowed to burn a few minutes before making observations. Repeated trials backwards and forwards resulted in a difference of 0·42 per cent. by altering the position practically nothing. However, if the precautions mentioned above are not strictly carried out, then discrepancies do arise. The disc should be moved, and not the standard, when making a comparison of this kind.

The burners are not all alike, for 2½ per cent. has been found, independent of the ends of the photometer. This difference was traced to the air-directing cone under the burner not having the same angle or shape. These cones, according to the specification, should be pointed; and the writer also affirms that the cone should have a definite height from base to apex. The angles found in some of those recently examined are—

Burner.	Angle. Degrees.	Height of Cone. Inch.	Apex.
Specification . .	57·50	0·480	Pointed.
DB	56·75	0·400	Not pointed.
ZZZ	56·75	0·375	..
586 Certified . .	53·75	0·350	..
587 „ . .	46·30	0·280	..
BB	58·00	—	..
A	44·30	—	—
SP	57·75	0·340	0·12 dia.
No title	Cone curved, and enters central air passage.		
WG	58·50	0·370	0·12 dia.

The SP standard was quite 0·5 candle less than any other; and the top of the cone was quite flat, as indicated by the diameter given. A cone having an angle varying half a degree or so would not matter; but there certainly ought not to be such wide differences as those indicated above. The shortness or flatness of the cone interferes with the inner air supply—this being the principal air current to an argand burner.

Experiments to Ascertain the Amount of Light Hidden by the "Cut-off" when Different Lengths of Flame are Used in Chimney.

2½-inch Flame .. 3-inch Flame .. 3½-inch Flame .. { Bar., 29·98.
0·3644 candle .. 0·7840 candle .. 1·7395 candles .. { Temp. 73° Fahr.

These average results are useful when studying the effect of parallax in relation to the position of the 10-candle standard in the photometer. According to the figures under the 3-inch heading and proved by trial, there would be an inappreciable effect on the disc, no matter whether the standard were set with the bottom of the "cut off" or the centre of the aperture central with the disc.

The result of having a heavy or a light atmosphere—commonly referred to as a high and low barometer, and one which is likely to occur over the British Isles—upon the standards of light is somewhat indefinite; but having had a barometer of 30·99 inches (Jan. 30, 1896) of mercury continuing for 7½ hours, and one of 28·91 inches (March 4, 1896) continuing for 5½ hours, experiments were made with the 10-candle standard under this range of 2·08 inches of atmospheric pressure, and no difference could be detected. So that the question of pressure does not enter as a difficulty to be overcome.

The Dibdin standard has been in daily use in a modern Letheby photometer for twenty months (from July 8, 1896, to March 31, 1898), to see what value it would accord to the outgoing gas as compared with candles and a Methven screen, with the following results :—

	By Candles.			By Methven Standard.	By Dibdin Standard.
Bar. Inch.	Temp. of Meter.	Time Alight b fore Testing. Mins.	Consumption of Sperm. Grs.	Ill. Power Accorded to Gas.	Short Slot· Ill. Power·	20 min. Burning. Ill. Power.
30·15	65·9°	21·54	41·05	16·57	16·62	15·65
No. of tests				3625	3628	3629

These experiments show that the Dibdin standard makes the gas going to London 0·92 candle, or 5·55 per cent., too low as compared with the return by the use of candles; while at the same time the Methven screen agrees with the candles.

Furnace Management.—In the course of a paper on the part played by chemistry in the management of furnaces, read at the second International Congress of Applied Chemistry, in Paris, by M. Damour, Chief of the Chemical Department at the Paris School of Mines, he observed, according to an abstract which appears in the "Engineer," that one of the consequences, and not the least important, of the continual progress of industrial firing, which daily gives rise to fresh applications of gas-producer and regenerative furnaces, is the possibility of regulating the combustion methodically and rationally. After dealing with the measurement of temperatures, analysis of the gases, calorific power of fuel, and pressure and speed of the gases, M. Damour observed that, for keeping a regular check upon furnaces, the first matter to be attended to is the temperature, not only in the furnace itself, but also in the regeneration chambers. The next point is the composition of the smoke, as it often happens that the excess of air attains 15 and even 20 per cent. of oxygen, which may lower the combustion point by 100° or 200° C. The proper management of gas-producers is the most effective element in regularity, while at the same time it is that wherein supervision is most necessary, because with a little negligence the gas may burn into carbon monoxide in the producer, and become very poor in heat-units.

TECHNICAL RECORD.

SOCIETE TECHNIQUE DU GAZ EN FRANCE.

Papers Read at the Annual Congress.

A recent issue of the "Journal des Usines à Gaz" contained abstracts of the papers presented at the annual congress of the above-named Society at Nice, general particulars of which have already been given in the "Journal."

The subject of increasing the yield of ammoniacal liquor in gas-works was dealt with by M. Brunet. When tar is removed from the well, it is found to contain liquor in suspension in a finely-divided state. In most cases this liquor is lost. It, however, has in it an appreciable quantity of ammonia, which is allowed to go the buyers of the tar. The author endeavoured to minimize this loss by proceeding as follows: The classic experiment which serves to demonstrate the solubility of ammonia in water gave him the idea of removing by a similar operation the greater portion of the ammonia held in suspension in the tar; the process adopted being to keep constantly upon the surface of the tar a layer of pure water to a height of at least 3 ft. 3 in. In this way there is a continual aspiration of the ammoniacal gases through the tar in contact with the water; and every time there is motion in the mass, the "pockets" of liquor, whether large or small, have a tendency to rise to the surface, carrying the ammonia with them. In order to keep a constant layer of pure water upon the tar, the superincumbent liquid is drawn off as soon as it is of 4 oz. to 5 oz. strength, and is replaced by a fresh supply. The water removed is run into a tank and used in the scrubbers. As the result of an experiment extending over more than two years, M. Brunet estimates at 132,000 gallons the quantity of pure water annually put into the wells direct, independently of that employed in the washing of the gas. The yield of ammonia was raised successively from 4 lbs. to 4¼ lbs. and 4½ lbs. per ton of coal carbonized; no other process having been employed to augment the quantity of the product extracted. This result was obtained without the help of any special apparatus for the removal of the ammonia from the gas; but it is thought that the methodical use of a washer would increase still more the yield above mentioned.

M. Desmazes gave an account of the working of the prepayment meter system for nearly two years at Nîmes; these meters having been introduced there in June, 1896. From the outset the movement was a success; and with the adoption of the new meter there was a marked increase in the number of ordinary installations. The demands were so numerous, that the staff of fitters had to be very considerably augmented. The average monthly consumption of gas per consumer was lower than had been expected; and, contrary to all expectation, the maximum consumption occurred regularly during September, October, November, April, and May, whereas a marked reduction took place in December, January, and February. During the hot months, gas was used for cooking purposes; in the cold weather the kitchen coke-stove possessed the advantage of heating the apartments without additional expense. The first result of the adoption of prepayment meters was a considerable extension of cooking by gas; but the advantage was less marked in the case of lighting. Thanks to the new consumers, the reductions in the sales of gas consequent upon the adoption of Welsbach burners and of electric lighting have been compensated for. The paper was accompanied by several tables, showing the effect of the introduction of prepayment meters on different classes of the population, and their distribution per house.

An account was furnished by M. Vautier of some photometric tests carried out by him of two Welsbach burners—No. 3A and No. 3B. The quantity of gas supplied was regulated to 5½ cubic feet per hour with a pressure of 22-10ths; and the orifices for the admission of air were fully open. The height of the mantles was 4·8 and 5 inches respectively. The burners were compared directly with the carcel lamp by means of a Lummer and Brodhun photometer; and the consumption was measured by a meter of the kind usually employed for photometric purposes. The temperature of the laboratory ranged from 64° to 68° Fahr. The first test was made with the mantle in a certain position; the second, with it turned 90 degrees; the third, with another turn of 90 degrees. Each test was repeated three times, with the photometer in its normal position; then three times more after the instrument had been turned 180 degrees. The conclusion arrived at by the author was that the No. 3 burner can be placed in the front rank of incandescent burners, where the gas is supplied at a pressure between 16-10ths and 24-10ths. Its luminous intensity reached 12 carcels (115 candles) with a consumption of 0·50 to 0·53 cubic foot per carcel-hour. The maximum intensity was attained with pressures of 22-10ths to 24-10ths. The gas consumption per hour was found to increase regularly from 5·3 to 7 cubic feet when the pressure rose from 16-10ths to 28-10ths.

M. Ad. Bouvier described the illumination of a school by diffused light from the ceiling. Six round burners, having a total consumption of 42·4 cubic feet of gas per hour, were replaced by four Welsbachs (No. 2), with Jena chimneys, and electrically lighted. The cost of the alteration was £15 13s., of which £8 was for whitening the ceiling and walls, and the remainder for the burners, reflectors, electric lighter, and labour

The author summed up his results as follows: The saving of gas was about 27 cubic feet per hour, exclusive of that effected by the lighting being done at the moment required; and the new burners gave off less heat. It was expected that the expenses of maintenance would be reduced to a minimum, owing to the relative elasticity of the suspension for the electric lighting. The inner sides of the reflectors, of course, had to be wiped from time to time. The light was distributed evenly, not only upon the horizontal plane, but upon the inclined planes of the desks; and there was, moreover, considerable improvement in the condition of the atmosphere.

M. Syssoyeff gave some particulars as to the progress lately made in lighting incandescent gas-lamps from a distance. During the past few years, various self-lighters have been devised in which the action of the gas upon some material such as spongy platinum, platinum black, or palladium, causes a rise of temperature sufficient to produce ignition. In the present case, the upper part of a Welsbach mantle is impregnated with material which heats up when absorbing gas, becomes red hot, and lights the gas, without any more trouble than turning a tap and waiting a few seconds. The system can be applied to the lighting of all kinds of gas-burners, as well as to gas-stoves. To the author's mind, the question of lighting gas solely by means of a chemical reaction has been successfully solved. It is to be hoped that the results obtained up to now in the laboratory will be confirmed in practice.

A cognate subject to the foregoing was dealt with by MM. Soubiran and Giroud; but in their case the arrangement consisted of a street-lamp tap with a flash-light and an electric lighter. On raising the lever of the tap, the gas passes by the flash-light. Continuing the movement, the small jet is lighted electrically, and simultaneously the gas arrives beneath the mantle. Completing the movement closes the communication with the flash-light, and the burner is lit without loss of gas or explosion in the interior of the mantle. The lighter is furnished with a portable battery; and the circulation of the electric current is so arranged that the lighting spark is produced at the top of the flash-light.

Two communications dealt with acetylene. M. Bouvier recounted the various accidents which have been caused by the use of pure acetylene, whether liquid or gaseous, compressed or not compressed. He explained the reason for acetylene being dangerous, and discussed the method of using it in solution in acetone and in a state of dilution. Looking at all the facts he brought forward, he thought he was justified in concluding that the use of pure gaseous acetylene requires a great many precautions; that the new illuminant is more dangerous than coal gas, especially in small appliances; that certain difficulties, notably the purification of the gas (phosphuret of lime being in the carbide) and the form of burner, have not yet been overcome; that in certain cases the employment of acetylene diluted with an inert gas—carbonic acid, for example—appears to be serviceable; that a mixture of coal gas and acetylene is utilized for the lighting of railway carriages; and, finally, that it is the manufacture of the gas in the house which causes most of the accidents. The other paper on this subject was by M. Monniot, who, having had opportunities of studying closely certain accidents of which he gave particulars, insisted upon the necessity for taking steps to counteract the effect of the confident assertions of the partisans of acetylene on the subject of the security attending its employment.

Tapping Water-Mains under Pressure.—The tapping of large water-mains under pressure is an undertaking accomplished much more readily now than it was a few years ago. We learn from the "Engineering Record" that a 40-inch main in Baltimore was recently tapped for a 30-inch branch, under the direction of Major W. L. Kenly, Chief Engineer of the Water Department. The cutting of the hole was accomplished in about two hours by means of a machine driven by a portable motor furnished with steam from a fire-engine.

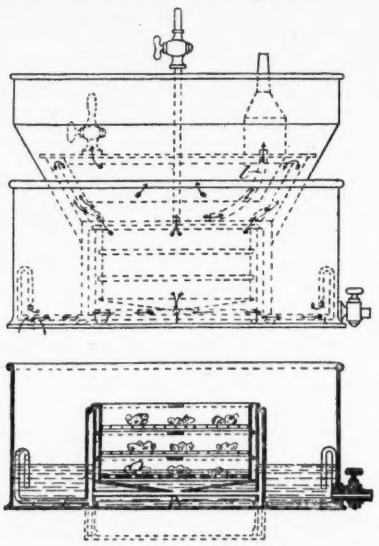
Gas Companies' Protection Association.—A meeting of the Preliminary Committee of this Association took place at the offices of Messrs. R. W. Cooper and Sons last Tuesday, when the draft rules which had been prepared were gone through and amended, and other matters of detail dealt with. A Sub-Committee, consisting of Mr. George Livesey, Mr. H. E. Jones, Mr. Shoubridge, and Mr. Helps, was appointed to finally revise and settle the rules. The first annual general meeting of the Association, of which Mr. F. E. Cooper is the Secretary (*pro tem.*), will be held in October next.

The Workmen's Compensation Rules, 1898.—Reference is made in our editorial columns to the issue by the Queen's Printers of the above-named Rules, which have been framed in accordance with the provisions of paragraph 10 of the second schedule to the Workmen's Compensation Act, 1897. It is therein specified that Rules of Court may be made generally for carrying the Act into effect so far as it affects the County Court, or an arbitrator nominated by the Judge of such Court, and proceedings in connection therewith. They are to be drawn up by the five Judges of the County Courts appointed for the making of rules under the County Courts Act, 1888; and, when allowed by the Lord Chancellor, they are to have full effect without any further consent. The Rules, with the appendix, occupy 56 pages.

REGISTER OF PATENTS.

Acetylene Gas-Generator.—Sutcliffe, H., of Halifax. No. 11,644; May 11, 1897.

This invention has for its object the construction of a stationary automatic acetylene gas-generator—preferably cylindrical in shape—within which is a perforated shelf or table. Beneath the shelf is a central tube communicating by other tubes or passages with the outside of the generating vessel. The cover is formed of a large dead-weight safety-valve, which has a discharge-pipe attached in the centre. The whole is inserted into a larger cylindrical cistern or vessel.



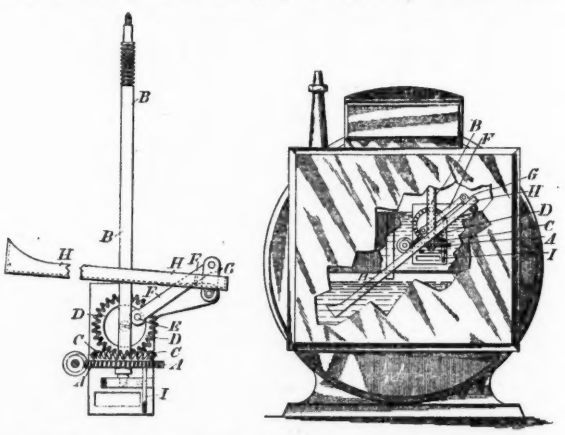
The engraving shows a complete apparatus (with the internal parts in dotted lines), and a section of the generator proper. By inserting the latter within the larger cylindrical cistern or vessel as described, "the least possible pressure is obtained automatically without leakage and with great safety." To charge the generating vessel, the cover or large dead-weight safety-valve is withdrawn; and after charging with suitable material, the outer vessel is filled to the required height with liquid, and the generator will then produce gas "automatically, either continuously or at intervals."

Cement for Repairing Gas-Retorts.—Crowther, A. W., of Huddersfield. No. 13,000; May 27, 1897.

This fire-cement is formed by the admixture, in about equal parts, of earths of a refractory nature—such as fire-clay, and gannister or silica. To these refractory earths is added about 25 per cent. of soda; and the whole is ground up and mixed in a mortar-pan or the like, and made into a paste by the addition of water. Barilla or other equivalent body may be added, if desired, for increasing the tenacity or adhering property of the cement for certain classes of work; or barilla may be substituted in some cases for soda.

Compensating Wet Gas-Meters.—Glover, R. T. & J. G., of St. John Street, Clerkenwell, E.C. No. 14,200; June 10, 1897.

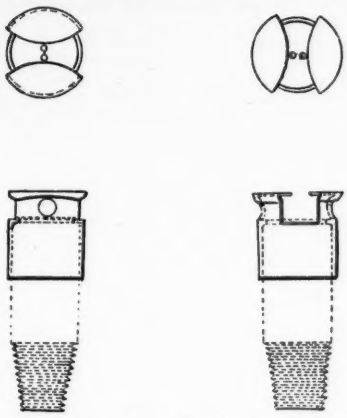
This invention relates to mechanism for operating the spoon from the main or index spindle of a wet gas-meter "in order to ensure great regularity and equal strain upon the drum during all parts of its revolution, and thus obviate any chance of the spoon sticking during, or on completion of, its movement while raising or lowering the spoon as is usual."



To the meter is fitted a crown or like wheel A upon the main or index spindle B; and in relation to it is arranged a bevel wheel C in gear with the wheel D, to which (by a pin or stud E) a link F leads, and is connected with a crank lever G of the pivoted spoon H, "for operating it steadily and continuously with the same amount of motion throughout its lifting and descending actions, whereby friction is reduced, and greater regularity of working ensured." I is a pawl to prevent any back-rotation of the pinion A.

Acetylene Gas Burner.—Kaestner, C., of Halle-on-Salle, Germany. No. 15,060; June 23, 1897.

The patentee proposes to provide a metal capsule placed on the burner so as to regulate automatically the admission of air in proportion to the



pressure of the gas; and thus secure complete combustion of the latter, whether the pressure increases or diminishes.

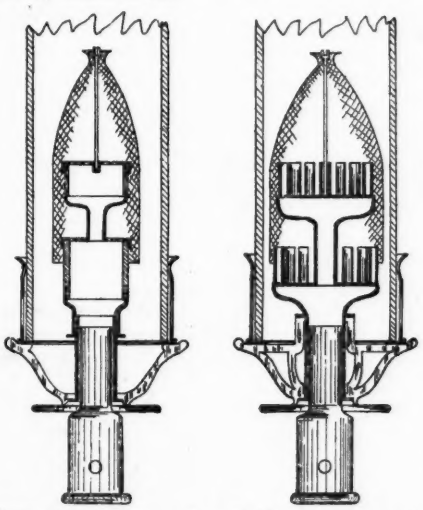
As shown, the capsule is composed of a cylindrical part furnished on its upper portion with a small internal shoulder, and having two extensions or circular cheeks extending upwards, and separated by a free space serving to disengage the flame. The cheeks are hollowed, and have openings at the sides, by which the air enters. When the burner is furnished with a capsule, the flame in filling the opening between the top cheeks at the sides produces a draught of air, more or less strong, through the circular openings and the chambers of the cheeks, according to the pressure. The amount of air introduced will thus be proportioned to the quantity of gas burned, and consequently "the combustion of it will be complete whatever the pressure."

Supporting Incandescent Gas-Mantles.—Silvester, M., of Brighton. No. 17,311; July 22, 1897.

The patentee proposes to combine with an incandescent gas-burner an adjustable clip or support for the lower end of the mantle, comprising a vertical arm or support adjustably or otherwise secured to the chimney gallery or other part of the burner, and vertically adjustable or other hinged or pivoted semi-circular arms, the free end of one of which arms is adapted to pass through a strap, loop, or socket on the other arm.

Incandescent Gas-Burner.—Schroedter, P., of Berlin. No. 16,727; July 14, 1897.

This invention refers to incandescent gas-burners formed of two or more complete burners placed one over the other, and to which the tube conducting the mixed gas is common. It serves the purpose of heating equally throughout their length hollow incandescence bodies of any shape and of any desired length.



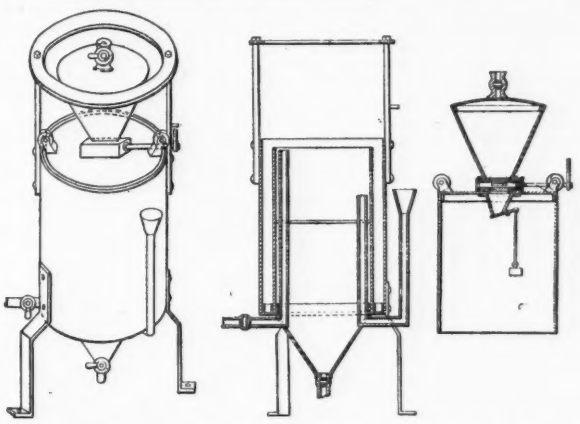
In one form of construction, above the burner rises a second burner with inlet tube, burner-head, and top covering plate; but corresponding to the upward contracting shape of the incandescence body, the top burner-head is of smaller diameter than the lower one. Each burner-head lies close to the mantle; and the heating effect of the lower burner-head extends to the outlet of the top burner-head, and the heating effect of the latter to the apex of the incandescence body. While a larger part of the upward flowing mixture of air and gas passes for combustion into the lower burner-top and heats the larger lower part of the incandescence mantle, a smaller portion of the mixture flows through the supply tube to the smaller burner and brings the top of the mantle to incandescence.

In a second form of construction, grouped tube-burners are used. On the bunsen tube is similarly fitted the uptake tube, which opens out trumpet-shaped, and thus forms the mixing chamber. The top closing plate of the latter is provided at its outer edge with a circle of holes, above which rise a circle of tubes; and above these tube-burners there is concentrically arranged a second smaller burner similarly formed.

In all forms of burners the separate burners may be either similar or different. Thus, for example, the first row may be a plate-burner, the second row a tube-burner, and the third row a circular slot-burner. For the top row also a tube-shaped incandescence body carrier may be used as the conductor for the gas and air mixture, and provided at a suitable height with side outlet openings and a burner-head surrounding it.

Manufacture of Acetylene.—Sigurdsson, O. V., of Hammersmith, W. No. 16,793; July 15, 1897.

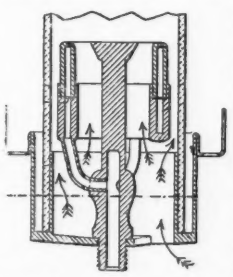
This invention relates to means employed in the manufacture of acetylene gas with a view to the delivery of the calcium carbide to the gas-generating chamber in proportion as the gas is consumed. The plant required in carrying it into effect is shown in the engraving: A perspective view of the complete apparatus, a vertical section of same with the bell or cover of the gasholder removed, and a vertical section of the bell or cover of the holder and parts carried thereby.



The calcium carbide (in powder or other convenient form) is placed in the hopper shown, at the bottom of which is a feeding chamber having an opening communicating with the supply chamber and another communicating with the gas-generating chamber. The feeding chamber has a valve of such construction as to be capable of communication with either the calcium carbide supply chamber or the gas-generating chamber separately, but cannot open communication to both chambers at the same time. The valve connections are also arranged in such manner that the bell or cover of the holder shall, on rising a given height, first shut off communication between the feeding chamber and the gas-generating chamber, and then open communication between the feeding chamber and the hopper; and, when the bell falls by the consumption of the gas, it shall first shut off communication between the feeding chamber and the supply chamber, and then open communication between the feeding chamber and the gas-generating chamber. It is also preferred to make the gas-generating chamber separate from the holder, to facilitate the removal of the lime refuse.

Gas-Burners.—Johnson, A. T. M., of Highbury, N. No. 19,601; Aug. 25, 1897.

This invention has for its object to obtain a circular or argand flame and to conduct to the inner and outer walls of the flame a supply of air so that "more perfect combustion, and therefore a more brilliant flame, will be obtained without any increase in the consumption of gas."



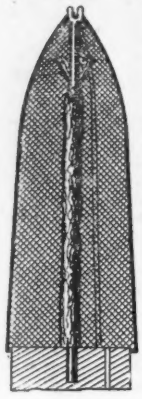
The cylindrical casing of the burner is fixed with a hollow stem or boss furnished with a threaded nipple adapted to screw into any existing gas-fitting, and provided at its upper end with a deflecting button. Around the upper part of the stem or boss is arranged an annular chamber supported upon the upper ends of pipes or conduits the lower ends of which are fixed with the tubular stem, and communicate with its bore. This annular chamber is formed with an enlargement or seat on which is dropped a hollow nipple, formed of steatite or other refractory material, which at its lower part is open, and at its upper part is formed with a ring of perforations, through which the gas issues. Beneath the nipple and within the seat there is arranged a gas distributor, consisting of a ring of wire gauze or perforated metal. The gas issuing from the perforations forms an annular belt of flame which creates a draught of air through the burner; and these currents pass through the length of the enclosed air-way formed by the cylinder (in the direction indicated by the arrows), and passing to the interior of the burner the air is, by the button head, caused to impinge upon the inner wall of the flame at or near the point of ignition.

Gas-Producing Material.—Zimmerman, J., of Chicago. No. 25,750; Nov. 5, 1897.

This gas-producing substance is made by crushing carbide of calcium, then mixing with it a binding agent of greater imperviousness to water, and then forming the resulting paste into cakes, sticks, or other forms, under pressure. The binding agent is a solution of shellac and alcohol; and after forming the concrete bodies, they are exposed to heat to eliminate the alcohol. The object of binding the particles of carbide together to produce cakes, sticks, or other bodies of any desired form, is to retard the action of water or moisture on them, so that they "can be preserved with greater facility, and so that, when employed for the formation of gas, they will decompose slowly and only as necessary—thus prolonging and regulating their action and increasing their efficiency."

Self-Lighting Incandescent Gas-Burners.—Frölich, B., of Reudnitz, Germany. No. 1168; Jan. 15, 1898.

The patentee claims as his invention the combination with the crutch of an incandescent gas-burner of a covering of oxide of thorium impregnated with finely divided platinum. This may be effected by wrapping the crutch with a textile fabric saturated with the solution of oxide of thorium, and afterwards subjecting it to heat until all the textile material is burnt away and only a porous covering of oxide of thorium remains upon the crutch. This porous body is then treated with a solution of any salt of platinum, and dried or heated; the operation being repeated if desired. Platinum in the finest state of division thus remains in the porous oxide of thorium, and the fine particles are prevented from being fused together. A small receptacle made of asbestos or the like may be placed (as shown) upon the crutch, so as to contain a small amount of spongy platinum. As soon as the gas is turned on, therefore, the cover of the crutch becomes red-hot and ignites the gas.



The same result may be achieved by impregnating the mantle with finely divided platinum in a manner similar to that described with reference to the crutch, either in addition to, or in substitution for the crutch; or it may have fine platinum wires combined with it.

APPLICATIONS FOR LETTERS PATENT.

12,199.—Graham, M., "Charging inclined gas-retorts." May 31.
12,200.—Morris, J., jun., "Fittings for gas-lamps and the like." May 31.
12,210.—Thorp, T., "Production of acetylene." May 31.
12,227.—Porter, W. H., "Gas-burners." May 31.
12,233.—Boulard, G., "Manufacture of acetylene gas." May 31.
12,245.—Lake, H. H., "Gas or other engines." A communication from L. T. Gibbs. May 31.
12,247.—Coe, J. S., "Thermostatic gas-regulators." May 31.
12,250.—Thompson, W. P., "Acetylene generator." A communication from The Gesellschaft für Heiz-und Beleuchtungs-wesen. May 31.
12,253.—Gent, J. T., "Tap or cock for controlling gas-supply mains and branches." May 31.
12,270.—Tabrar, J., and Evans, J. A., "Taps for gas, water, and like purposes." May 31.
12,295.—Evans, E., "Generating and storing acetylene gas." June 1.
12,356.—Sieverts, W. H. A., "Forming incandescent bodies for gas-lighting." June 1.
12,401.—Scarth, J. E., "Generation of acetylene gas." June 2.
12,424.—Eilers, H. J., and De Bruyne, C., "Pressure-regulators for incandescent gas-light burners." June 2.
12,434.—Burden, E., "Gas or oil stoves." June 2.
12,469.—Levetus, E. L., "Acetylene generators." June 3.
12,487.—Edwardes, E. J., "Acetylene gas-lamp." June 3.
12,491.—Boult, A. J., "Acetylene gas-generators." A communication from Societe Italiana Pel Carburo di Calcio acetilene ed altri gas. June 3.
12,495.—Abel, C. D., "Prepayment mechanism for gas and other fluid meters." A communication from T. T. Somerville. June 3.
12,500.—Sassmann, W., "Acetylene gas-generator." June 3.
12,505.—Crowther, H. W., and Harris, H. G., "Pellets for igniting gas." June 3.
12,510.—Ernst, O., and Philips, A., "Producing acetylene gas." June 3.
12,530.—Hallet, A., "Acetylene gas-generator." June 4.
12,586.—Abel, C. D., "Feeding gas-retorts." A communication from Société Anonyme Continentale Pour la Fabrication des Compteurs a Gaz et Autres Appareils. June 4.
12,588-9.—Mayer, C. P., "Automatic gas-vending apparatus." June 4.
12,694.—Parker, G. E., "Acetylene gas lamps and generators." June 7.
12,698.—Boult, A. J., "Acetylene gas-generators." A communication from J. Desforges. June 7.
12,700.—Sherwood, I., junr., "Chimney for gas and other burners." June 7.
12,725.—Kuhne, A., and Meeks, J. C., "Gas regulator and economizer." June 7.
12,772.—Fritz, F., and the Daylight Incandescent Mantle Company, Ltd., "Burners for gas lighting by incandescene." June 7.
12,998.—Major, J., "Acetylene gas-lamps." June 10.
13,029.—Jackson, F. A., "Generating acetylene gas." June 10.
13,055.—Glover, R. T. & J. G., "Burners for incandescent gas lighting." June 10.
13,070.—Forbes, Sir C. S., "Generation and supply of acetylene gas." June 11.
13,104.—Böhndel, H. H., "Ignition body for gas-lights." June 11.
13,129-30.—Bennett, J. F., and Moorwood, H. S. & T. P., "Gas and oil engines." June 11.
13,149.—Lecca, T. C., "Generating acetylene gas." June 11.
7280A.—Rosinski, S., and Ducruix, V. E., "Automatically lighting gas." June 15.
13,164-5.—Naef, P., and Garton, R. S., "Producing coke, gas, and bye-products." June 13.
13,185.—Donaldson, W., "Vaporizing inflammable oils, and storing the gas produced at constant pressure for use in heating, lighting, and gas-motors." June 13.
13,232.—Thwaite, B. H., and Allen, H., "Effecting the slow action of water upon calcic carbide." June 14.
13,292.—Thompson, W. P., "Improved gas-motor." A communication from La Société Aubry and Morel and A. Blondeau. June 14.
13,387.—Abel, C. D., "Generating acetylene." A communication from P. Lipcke. June 15.
13,474.—Rickard, J. R., "Gas and like motors." June 16.
13,487-8.—"Cannon" Hollow-Ware Company, Ltd., and Ward, T., "Gas cooking-stoves." June 17.
13,504.—Koch, A., "Manufacturing durable incandescent illuminating bodies." June 17.
13,559.—Plaissetty, A. M., "Atmospheric burners." June 17.
13,567.—Wollaston, H. U., "Increasing the pressure of gas supplied to burners." June 17.
13,573.—La Societe Chaussard et Cie., and Vignes, C. E., "Portable acetylene gas-lamp." June 17.
13,598.—Hutton, E. K. & W., "Acetylene gas-generator." June 18.
13,599.—Peebles, D. B., "Coin-prepayment mechanism for fluid meters." June 18.
13,617.—Tylor, J. J., "Rotary water-meters." June 18.
13,636.—Forbes, Sir C. S., "Acetylene-generators." June 18.
13,645.—Smith, W. R., "Production of carbide of calcium." June 18.
13,651.—Yates, H. J., and Prior, J. D., "Atmospheric burners for gas-fires." June 20.
13,698.—Sales, G. de R. de, "Mixing gases." June 20.
13,720.—Minshall, T. H., "Coin-freed meter mechanism." June 20.
13,737.—Renouf, P. L., "Gas-motors." June 21.
13,830.—Boult, A. J., "Producing acetylene gas." A communication from O. Payan. June 21.
13,875.—Pennington, E. J., "Manufacture of gas." June 22.
13,968.—Forbes, Sir C. S., "Acetylene lamps." June 23.
13,984.—Sondermann, E., "Gas-regulator." June 23.
13,987.—Ebert, W. V., "Generating and burning acetylene gas." June 23.
13,990.—Wiltshire, G., "Producing acetylene gas." June 24.
14,035.—Winkler, H., "Gas lamps or lanterns." June 24.
14,037.—Zschocke, G., "Gas-scrubbers." June 24.
14,040.—Shedlock, J. J., "Gas-producing apparatus." June 24.
14,049.—Rosenthal, K. E., "Generators for acetylene gas." June 24.
14,050.—Billwiller, J., and Rosenthal, K. E., "Generators for the production of acetylene gas." June 24.
14,075.—Jefferies, W. F., and Champion, A., "Gas and other stoves." June 25.
14,086.—Lees, W. & T. W., "Valves for steam, water, gas, and other liquids or fluids." June 25.
14,132.—Durban, W. L., and Gore, J., "Production of calcium carbide." June 25.
14,135.—Dymond, J., "Burners suitable for use in incandescent gas lighting and for other purposes." June 25.
14,139.—Forbes, Sir C. S., "Manufacture of acetylene gas." June 25.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Position and Prospects of Incandescent Gas Lighting.

Sir,—I think a perusal of the specification of patent No. 105 of 1883 [see "Journal," Vol. XLII., p. 408] will satisfy your correspondent, "Technologist," that one of the rivals he refers to certainly has not a patent upon which a monopoly can be founded.

A. Clarke.

June 30, 1898.

The Philadelphia Gas Undertaking.

Sir,—In your issue for the 28th ult., a letter headed "An Object-Lesson in Municipal Gas Supply" should rather have been called "An Anachronism in Supply," if viewed in the light of municipal progress the whole world over. That the City of Philadelphia paid $3·14 for coal when they could get it for $2·95 is a fact for Philadelphians to inquire into. However, I have to particularly notice the following statement of Mr. M'Dougall: "It is evidently unfair to the general public for employees of a Municipality to be paid more than the market rate of wages." As a broad principle, this is erroneous; for in many cases the market rate of wages is so low that workmen will not do justice to their work, neither can they be expected to do so. If a Municipality pay their workmen rather more than the market rate, they will attract better men to their employ, and get better work done, with the result that the whole community are benefited in consequence. It would be interesting to know the difference in the relation of wages to total expenses and the relation of salaries to total expenses in the Philadelphian gas undertaking.

A Student of Economics.

July 2, 1898.

West's Gas Improvement Company, Limited, have in hand a number of important orders for various special types of machinery and plant for gas-works. In connection with stoking machinery, the firm will, during the present year, fit up 54 charging and drawing machines, for fourteen retort-houses in various parts of the country, on the Continent, and at Buenos Ayres. They have also put up a number of coal-conveyors for coal-stores, and are making a speciality of plant for conveying hot and cold coke from the retort-house. For this and other purposes they have taken up the manufacture of the Hunt roller-chain, introduced and patented by Mr. Charles Hunt, which has been found to be exceptionally well fitted for dealing with materials of so gritty and cutting a nature as coke. The firm have just completed a West-Jenkins air-compressor, with double-stage compression and intermediate cooler, for the Crystal Palace District Gas-Works; and similar machines are being built for the Newcastle, Nottingham, and Sheffield works. The continued growth of their business has necessitated a considerable enlargement of the Company's works and plant; and they have now practically completed the extensions to which brief reference was made in these columns some time ago. In the machine shop they have made considerable additions to the plant—including three lathes and four drilling-machines of the most modern type; the pattern-shop has been enlarged to almost twice its previous capacity; and a new platers' shop has been opened. Perhaps the most important portion of the extensions is a separate department for the manufacture of retort mouthpieces—a branch of the Company's business which has grown considerably of late years. This shop, which is 33 feet wide and 150 feet long, is traversed by an overhead rope-driven crane; and in it is erected plant specially designed for this class of work.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Monday, June 27.

ROCHDALE CORPORATION WATER BILL.

On the motion for the third reading of this Bill,

The Earl of CREWE moved that the Bill be re-committed. He explained that by the Bill the Corporation of Rochdale proposed to take water from the Calder Valley in Yorkshire—a populous district, the centre of the woollen trade. This would injure the millowners and others in the district, as all the collecting areas were already well occupied. The West Riding County Council, which represented all the Local Authorities, objected to the Bill on general grounds; but the Committee of the House declined to hear them because they had no *locus standi*. He asked that the Bill should be re-committed so that the Council might be heard.

Lord HAWKESBURY (the Chairman of the Committee who considered the Bill) pointed out that the County Council were not a water authority. It was true they claimed to represent a large number of Local Authorities; but there was not one word to this effect in their petition. He trusted their Lordships would support the Committee.

The Earl of MORLEY said it was quite clear that the Standing Order under which the Committee acted was a purely discretionary one. It would, he thought, be very dangerous if their Lordships, without the assistance of all the arguments which the Committee heard, and of the maps which they had before them, reviewed the decision arrived at. It had not been alleged that this decision was contrary to any of the rules or precedents of the House, or that any injustice had been done. It seemed to him that such cases as that now referred to must be taken on their merits. In this particular one, it would be somewhat dangerous if the House were, on what must be an *ex parte* statement, to review the decision arrived at unanimously by the Committee after a full hearing.

After some further remarks, the motion was rejected.

Friday, July 1.

BOROUGH FUNDS BILL.

Earl BEAUCHAMP moved the second reading of this Bill, and explained that its object was to amend the Borough Funds Act, 1872, and the Borough Funds (Ireland) Act, 1888, in certain particulars, including that of limiting the power to take a poll, which had often caused great and unnecessary expense.

The Earl of MORLEY said he must object to some of the details of the Bill; but he had no desire whatever to stand in the way of its second reading. He wished the noble Lord to know, however, that there were certain points in it to which he would have to ask him to direct his attention.

After a few remarks from the Earl of WEMYSS,

The Bill was read a second time.

The following further progress has been made with Bills:—

Bill brought from the Commons, read the first time, and referred to the Examiners: Leyton Urban District Council Bill.

Bills read a second time and committed: Clacton-on-Sea Gas and Water Bill, Coventry Corporation Gas Bill, Cromer Gas Bill, Drogheda Gas Bill, Higham and Hundred of Hoo Water Bill, Leyton Urban District Council Bill, Local Government Provisional Orders (Gas) Bill, Maldon Water Bill, Middlesbrough Corporation (Gas) Bill, Mid-Kent Water Bill, Wey Valley Water Bill.

Bill reported: Norwich City Water Bill.

Bills reported, with amendments: Cranbrook District Water Bill, Crawley and District Water Bill, Gainsborough Gas Bill, Southwark and Vauxhall Water Bill, Tottenham and Edmonton Gas Bill, Wigan Corporation Bill, Wishaw Water Bill.

Opposition withdrawn: Southampton Gas Bill, Wigan Corporation Bill.

Bills read the third time and passed: Forres Water Bill, Gainsborough Gas Bill, Gas Orders Confirmation Bill (No. 2), Heywood Corporation Water Bill, Newcastle and Gateshead Water Bill, Northam Urban District Water Bill, North Warwickshire Water Bill, Norwich City Water Bill, Southend Water Bill, Southwark and Vauxhall Water Bill, Staines Reservoirs Joint Committee Bill.

Bills Royal Assented: Bakewell Gas Bill, Brompton, &c., Water Bill, Enfield Gas Bill, Gloucester Gas Bill, Ilkeston Corporation Bill, Market Harborough Gas Bill, St. Anne's-on-Sea Gas Bill, Southend Gas Bill, Thanet Gas Bill, York United Gas Bill.

The Gaslight and Coke Company Bill, the Matlock Urban District Council Bill, and the Rhymney and Aber Valleys Gas and Water Bill have been referred to a Select Committee, consisting of Lord Clinton (Chairman), Lord De Saumarez, Lord Raglan, Lord Hare, and Lord Amherst of Hackney; to meet on Tuesday, July 5.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills read the first time, and referred to the Examiners: Forres Water Bill, Gas Orders Confirmation Bill (No. 2), Heywood Corporation Water Bill, Newcastle and Gateshead Water Bill, Rochdale Corporation Water Bill.

Bills read a second time and committed: Bury Corporation Bill, Carlisle Corporation Water Bill, Gas Orders Confirmation Bill (No. 1).

Bills reported: Bacup Corporation Water Bill, St. Helens Corporation Bill.

Bills read the third time and passed: Hamilton Water Bill, Leyton Urban District Council Bill, Kettering Water Bill, Market Harborough Gas Bill, Todmorden Corporation Water Bill.

Petitions have been presented against the Bury Corporation Bill, from the Bury Rural District Council, the Corporations of Rawtenstall and Haslingden, and the Urban District Councils of Little Lever, Radcliffe, Ramsbottom, and Whitefield.

HOUSE OF LORDS COMMITTEE.

(*Before the Earl of* NORTHBROOK, *Chairman, the Marquis of* LOTHIAN, *the Earl of* GLASGOW, *Lord* ABERDARE, *and Lord* SHERBORNE.)

CENTRAL POWER DISTRIBUTING COMPANY BILL.

This Bill, the object of which is to enable the Company to supply electricity for lighting, traction, and other purposes to a district embracing an area of 2000 square miles, including the towns of Sheffield, Rotherham, Lincoln, Gainsborough, Newark, Nottingham, Ilkeston, and Worksop, came before the above-named Committee on the 21st ult. It is proposed to erect a central station at Warsop—a place midway between Worksop and Mansfield—in the midst of a colliery district; and the promoters state that, by the use of coal slack for generating purposes, which they will be able to procure at 2s. per ton, they will be able to produce electrical energy at an extremely cheap rate. In view of the large average demand which they hope to develop in the area of supply, they expect to be able to sell electricity at 1d. or 1½d. per unit; whereas the present charge in Nottingham, where the electric light works are in the hands of the Corporation, is 4d., having been reduced to this figure from 6d. since the Bill was introduced. Petitions against the Bill had been presented by the Corporations of Nottingham, Sheffield, Lincoln, Rotherham, Doncaster, Ilkeston, and Chesterfield; the Urban District Councils of Bakewell, Belper, Matlock Bath, Mexborough, Wombwell, Worksop, and Heanor; the Sheffield Electric Light and Power Company, and others. There were, however, upwards of seventy petitions in its favour.

The case for the promoters was opened by Mr. Pember, Q.C., who said that the scheme, which was a new departure, was to supply electricity for all purposes over a large area in the Midlands, comprising collieries and manufactories of all kinds. The share capital proposed by the Bill was £750,000, with borrowing powers to the extent of £250,000; and the promoters were such that there was no possible doubt of their financial ability—the first name being that of Colonel Thackeray, a partner in the firm of Messrs. Thackeray and Sons, one of the oldest and most important firms in Nottingham. By the Bill, Sir T. Thompson, Bart., Mr. W. A. M'Arthur, Mr. E. A. Lazarus, Mr. Arnold Lupton, Mr. R. Monks, Mr. J. W. Thackeray, and Mr. Markham were incorporated as a Company for carrying out the object in view. The learned Counsel explained the origin of the scheme. He said it became apparent last year to certain gentlemen with large industrial interests how great were the advantages enjoyed by manufacturers in America and on the Continent from the supply of electricity for power over a large area; and they thought that some effort should be made to obtain similar advantages for the trade of this country. The Board of Trade were far from discouraging such a project; but they did not see their way to making the scheme the subject of a Provisional Order, which in this instance would have dispensed with the necessity of obtaining the consent of about a hundred Local Authorities. Accordingly, the Board recommended procedure by Bill. Certain other Bills were before the authorities in the two Houses of Parliament, involving new departures in the same direction. It was perceived, in fact, that electrical enterprise was starting anew, and had outgrown parochial limits. The main obstacle to the application of the industry on a really beneficial scale had been the veto of the Local Authorities in certain important respects. A Joint Committee of Lords and Commons was appointed to consider the question—Lord Cross being the Chairman; and the Committee took a good deal of evidence concerning the compulsory acquisition of lands, the establishment of generating stations, and the veto of the Local Authorities. He (Mr. Pember) thought the Committee would agree with him that the old days of veto were over, and that it was now only a question of *locus standi*. He urged, with the greatest possible submission, that the present case must be judged on its merits, and that all questions of veto must be considered at an end; the only point being whether or not, on the merits, any particular Corporation could claim that special circumstances entitled them to ask to be left out of the operation of the Bill. The majority of the petitions against the Bill were from the Local Authorities over the area of supply, and were full of this topic. The promoters of the Bill, in common with those responsible for other measures, appeared before the Joint Committee and gave evidence as to the great utility of such schemes, and the cheapness with which electricity could be supplied by them. On that occasion, he argued that there was a danger of an undue tenderness for the principle of local self-government being allowed to work great commercial harm; and to some extent the Joint Committee appeared to have agreed with this opinion. Nothing was so important, from the point of view of securing a cheap supply, as a large and constant average demand. In the area comprised in the Bill, the necessary conditions of such a demand were unusually well developed. The generating station was to be established in a country district, and close to a large colliery, whence they would be able to obtain a particular class of coal—a kind of slack—at as low as 2s. a ton. The Bill proposed to supply electricity at 1½d., and in some cases at as low as 1d. per unit. They asked for no monopoly; and there was a clause distinctly saying so. He had a long list of petitions in favour of the Bill, including some from the Sheffield and Nottingham Chambers of Commerce, users of machinery, District Councils, and other influential bodies. On the other hand, there were petitions praying the House to reject the Bill on the ground that the promoters would have power to break up streets and interfere with traffic; and saying that the scheme was speculative, and that its adoption would unfairly interfere with existing powers. There were two scales of charges in the Bill; the lower one being for the supply of electric energy in large quantities.

The first witness called was Mr. Arnold Lupton, Professor of Coal Mining at the Yorkshire College, Leeds, who stated that, in his opinion, the scheme was in the interests of the localities intended to be served. The site of the generating station had been selected for geological reasons—being in the centre of one of the richest coalfields in Great Britain—and coal would be supplied under contract at the rate of 2s. a ton. The scheme would save the manufacturer spending his capital and energy in the production of power, and was therefore an important step in the division of labour. Asked by Mr. Balfour Browne, Q.C., who represented the Sheffield Corporation, whether he thought that, as a matter of principle, a Company ought to be allowed to come in and compete with a

Corporation like Sheffield, who, were there a demand, could supply the whole town, witness said he considered that it was absolutely essential for the progress of the country that companies should be allowed to compete. He believed they could do so successfully. The scheme before the Committee would really allow of the sale of energy at wholesale instead of retail prices. If such places as Sheffield, Rotherham, Newark, and Nottingham were excluded, he doubted whether the scheme would be successful. Mr. Bainbridge, M.P., followed, and expressed the opinion that the scheme was one of the most progressive ever put forward in the interests of a large district and a vast population.

On the following day, further evidence was given in support of the Bill; among the witnesses being the Duke of Newcastle, who expressed an opinion that the measure would confer great advantages on the mining districts included in his estates. If the scheme were carried out, he would employ electricity for the lighting of Clumber, and for other purposes. In cross-examination, the Duke admitted that the Corporation of Nottingham had lately laid down mains to supply his estate in that city with electricity under an agreement; but he said he would prefer to have two strings to his bow, so that his tenants might have the advantage of a cheap supply. Colonel Thackeray said his firm, who employ 500 hands, approved of the proposals of the Bill for such a supply of power as the promoters could afford. Moreover, it would be useful to individual workmen, and would, he anticipated, send manufacturing to a great extent back again to the villages. He thought that the class of men who used the handloom in the hosiery trade would, if such a supply as that proposed were available, again work in their own homes. Their families would be able to manage one or two machines. Mr. T. Bayley, M.P. for the Chesterfield Division, said he believed the scheme would be an advantage to the mining and agricultural parts of his constituency, because they would get cheap motive power, and there would be a greater amount of work for the women with the birth of small industries, for which in the villages there was great requirement. The distribution of electric power must, he thought, be a benefit to the large colliery villages. Mr. G. H. Davies, a surveyor and valuer, expressed the opinion that the "penny-in-the-slot" system of supplying electrical energy would be of advantage. This, of course, was only one of a hundred ways in which this scheme would be of service.

Next morning, other witnesses were called to support the Bill; several electrical experts, including Mr. James Swinburne, expressing the opinion that the scheme had every prospect of becoming a commercial success.

At the close of the promoters' case, Mr. Balfour Browne addressed the Committee on behalf of the Corporation of Sheffield, who, he declared, strongly objected to having to meet the competition in the supply of electricity of an outsider. If the new Company were to be allowed to carry on their operations at all in Sheffield, it ought to be at the risk of having to purchase the electric light undertaking now in existence there. The promoters, he contended, would not be able to furnish a cheaper supply than the Corporation, as the price of coal differed but little at Sheffield and Warsop. He thought they could hardly really intend to carry out the scheme; and he suggested that the Bill was being pushed forward with some ulterior motive. The Lord Mayor of Sheffield (the Right Hon. A. G. Franklin), in giving evidence against the Bill, said the Corporation were building an electricity generating station for the working of the tramways, and had entered into an agreement with the Sheffield Electric Light and Power Company to purchase their concern. They had thus involved themselves in an expenditure of about half-a-million of money, and were naturally opposed to an outside Company obtaining power to compete with them. The Sheffield Company had offered to supply large quantities of electricity at the rate of 1d. per unit; and he did not think this rate could be lowered by the proposed Company.

At the outset of the proceedings on the following day, the Chairman suggested that if the promoters of the Bill would take it that the Sheffield Corporation were willing to supply the city with electrical energy when they had possession of the undertaking of the Electric Light and Power Company, further evidence on this point might be dispensed with, and the proceedings shortened. Mr. Pember replied that, though he should like to grant all he could, he had no means of admitting anything as to price or quality, except through witnesses, whom he would like to cross-examine on these points. Further evidence was then called in opposition to the scheme. Sir Charles Skelton, ex-Mayor of Sheffield, expressed a strong opinion that the Corporation ought to have the monopoly of the supply of electricity within their area. Replying to the Marquis of Lothian, he said that if the new Company would be content to sell power wholesale in bulk to the Corporation, without attempting to supply direct to the consumers in the city, it would largely diminish opposition, as the Corporation objected chiefly to the disturbance of the streets which the scheme would entail. Mr. R. Hammond gave statistics of expenditure by corporations and companies in respect of electric light undertakings in the United Kingdom, with the object of showing that the capital of one million sterling proposed by the new Company was inadequate. Major-General Webber gave corroborative evidence. The objections to the scheme of a number of the smaller Urban District Councils in the proposed area having been stated by Mr. Wedderburn, Q.C., and those of the Corporations of Lincoln and Ilkeston by Mr. Lewis Coward and Mr. Lissett respectively, witnesses were called on behalf of the Rotherham Corporation against the Bill. Among these was Professor Kennedy, who stated that he was engaged in carrying out various electrical works at a cost of £1,500,000, and had compared the proposals of the Bill with what was actually done in two places with which he was concerned. In Oldham, which was not unlike the towns in the district proposed to be served by the Company, they were already supplying electricity, though on a small scale, on exactly the terms of the Bill—viz., a differential rate between 4d. and 2d. per unit; while in Edinburgh, where the Corporation also owned the electric lighting works, and where the output was very much larger, the charges to the public had been reduced to 3½d. per unit for lighting and 1½d. for power. He cited these cases as showing that municipalities not only could, but did already, supply the current to general consumers at rates at least as low as, and in a number of cases lower than, those of the Bill. There were a number of other cases in which corporations were making terms with tramway companies to supply them with current for traction purposes at rates varying from 2d. to 1d. per unit; and they would realize a profit at these prices.

On the resumption of the proceedings on Monday last week, the opposition of Rotherham, Doncaster, and Chesterfield was proceeded with. At the close of these cases, evidence was called in support of the petition of the Nottingham Corporation against the scheme. Among the witnesses examined was Dr. E. H. Fraser, the Mayor of that borough, who said that the Corporation had practically laid out a quarter of a million sterling on their electric lighting undertaking; and, as they proposed to work the tramways by electricity, they would probably before long spend another large sum. They viewed the proposal of the Company, as set forth in the Bill, with dismay, and were perfectly unanimous in asking the Committee to reject the scheme. Nottingham had acquired the gas and water undertakings, and also the tramways, largely in consequence of the incessant disputes which their possession by private authorities involved in regard to the opening of the roads. By the 1st of July, the price of electricity, both for light and power, charged by the Corporation would be less than that scheduled in the Bill. Witness declared that the Nottingham Chamber of Commerce, which had petitioned in favour of the Bill, was a very small and unimportant body. Sir J. Turney, the Chairman of the Electricity, the General Works, and the Highways Committees of the Nottingham Corporation, was also called. He said the electric light undertaking had been a thoroughly successful one. They had been supplying light at 6d. per unit, and power at 3d. per unit; and the price had recently been reduced. Owing to their success, the Council had decided to extend the central station. At the present time they had 3000-horse power; but they were going to more than double it—bringing it up to about 7000-horse power. They made £3500 profit last year, and placed it to a reserve fund. They had not fixed the present prices without due consideration; and they had no doubt about making a profit. He strongly objected to a Company coming in, because he believed the Corporation could supply electricity at as cheap a rate. The Corporation were going to sell at 2d. per unit for the first four hours, and at 1d. afterwards. Mr. H. Talbot, the Corporation Electrical Engineer, said he did not believe the proposed Company would be able to supply light or power cheaper than the Corporation. Dr. Hopkinson stated that, in his opinion, neither in the Bill nor in their evidence did the promoters give a clear idea as to carrying out the proposed scheme. So far as Nottingham was concerned, it was in an advantageous position; and he was convinced that the Corporation could supply electricity cheaper than the Company. He saw no reason whatever for disturbing the right of the Municipality; and he thought if an outside Company entered Nottingham it would be a loss to the city.

On the re-assembling of the Committee on Tuesday morning, they were addressed by Mr. Pope, Q.C., on behalf of Nottingham. He argued that, as in the cases of gas, water, and locomotion, the tendency of Parliament had been to vest all public commodities in the communities themselves; and they had decided that, where a municipal body was able to supply itself, no competitor should be allowed to come in. Nottingham was in such a position that there was no shadow of reason why the city should be subjected to inconvenience and cost in order simply to allow a speculating body to obtain the high load factor necessary to the success of their scheme. In reply, Mr. Pember denied the general proposition set up by Mr. Pope in regard to parliamentary opinion. He contended that the Joint Committee had recognized the development that was to ensue in regard to electricity as a motive power, and that their recommendations were distinctly in favour of granting powers to such bodies, and under such conditions, as those embodied in the Bill.

At the close of Counsel's addresses, the Chairman announced that the Committee found the preamble of the Bill proved. They intimated, however, that they were prepared to consider any clause which Corporations within the Company's proposed area of supply might suggest for the purpose of giving to them greater power than they now possessed in respect of the laying of the Company's mains through their thoroughfares. They also decided that a clause must be inserted to enable Corporations to take from the Company electrical energy in bulk for the supply of their respective districts. With regard to the construction of the Company's central generating station at Warsop, the Committee held that some limit of time must be inserted in the Bill. On hearing this announcement, the Counsel representing the Corporations of Nottingham, Sheffield, Doncaster, Chesterfield, Lincoln, Ilkeston, and Rotherham intimated that they would take no further part in the proceedings before the Committee. The general consideration of clauses was postponed; but one giving Corporations power to purchase electricity in bulk, but reserving to the Company the right to serve consumers of 10,000 volts and upwards, was accepted, and some other conditions were imposed.

The Committee met again on Thursday for the purpose of considering the clauses of the Bill. In accordance with the intimation given at the previous sitting by the Counsel for the leading opponents of the measure, the promoters alone were represented. Among the alterations and amendments made in the Bill was the insertion of a clause providing that, if the Company should not, within five years after the passing of the Bill, have proved to the satisfaction of the Board of Trade that they had expended upon their undertaking the sum of £50,000, the powers granted to them should cease and determine. With regard to supplying electricity in bulk, the clause submitted to the Committee on Tuesday was reconstructed and passed in the following form:—

The following provisions shall not apply, except so far as may be agreed to the contrary between the Company and the Corporation of any borough which at the time of the passing of this Act shall be supplying electrical energy, or have obtained an Order or Act empowering such Corporation to supply electrical energy:—

1.—The Company shall, six calender months before commencing to distribute electrical energy within any such borough, give notice in writing of their desire so to do to the Corporation; and the Corporation shall, within three months after receiving such notice, be entitled to serve upon the Company a counter-notice indicating their desire to undertake such distribution themselves, and to purchase from the Company a supply in bulk. The terms of such supply in bulk, as to price, minimum amount, and all other details, shall, failing agreement between the Company and the Corporation, be determined by an arbitrator, and the Corporation shall be at liberty to enter into an undertaking to take from the Company a supply in bulk according to the terms so agreed or settled by arbitration as aforesaid, for a period of three years at the least; and thereupon the Company shall, save as hereinafter mentioned, be restrained for such period from distributing electrical energy under the power of this Act within the said borough.

2.—In the event of the Corporation failing to give such counter-notice, or, having given the same, failing to enter into such undertaking to take a supply in bulk, the Company's powers to supply within such borough shall be unaffected by the provisions of this section.

3.—Provided that if at the end of the said period of three years and any subsequent period of three years the Corporation shall give notice of their desire to continue the taking of a supply in bulk, the Company shall continue to give such a supply, at a price and minimum amount to be agreed between the parties, or, failing agreement, to be determined by arbitration in the manner hereinbefore provided; and thereupon the provisions of this section shall apply to the extended period.

4.—Whenever the Company make default in supplying in bulk to the Corporation as aforesaid, the Company shall be liable to pay and shall pay to the Corporation, in addition to the penalties for failures to supply by this Act provided in the case of any owner or occupier, all damages, costs, charges, and expenses which the Corporation may be under liability to pay, or shall have paid, in respect of failure of supply or pressure, which liability shall have arisen by reason of the default of the Company as aforesaid, and the amount of such penalties shall not be limited by anything contained in the section of this Act the marginal note whereof is "Penalty for Failure to Supply."

Provided that, in any event, the Company shall be at liberty to supply to any person within such area, for trade purposes, who is willing to undertake to receive a supply of not less than 10,000 Board of Trade units per annum.

On the question of maximum price, the Committee decided that this should be 4d. per unit for small, and 2d. per unit for large, consumers, with the proviso that if the average charge in any one year is not more than 3½d. per unit, the Company may divide 10 per cent., if they earn it, and an increased dividend with any lowering of that average.

HOUSE OF COMMONS COMMITTEE.

(*Before Colonel* GUNTER, *Chairman, Sir C.* PALMER, *Major* WYNDHAM-QUIN, *and Mr.* J. HOWARD.)

STIRLING GAS BILL.

This Bill, which has already passed the House of Lords, was under the consideration of the above-named Committee from the 21st to the 23rd ult. Its object, it may be remembered, is the conversion of the Company into a statutory undertaking, with additional capital and other powers; and it was opposed by the Corporation of Stirling.

The promoters' case was conducted by Mr. Pembroke Stephens, Q.C., Mr. D. Dundas, Q.C., Mr. J. D. Fitzgerald, Q.C., and Mr. Nelson; the opponents being represented by Mr. Balfour Browne, Q.C., Mr. Blennerhassett, Q.C., and Mr. Rigg.

In opening the case, Mr. Pembroke Stephens said the Bill was promoted by the Stirling Gas Company with the object of being constituted a statutory Company. It had come from a Committee of the House of Lords, presided over by the Duke of Richmond; and the only opposition was from the Corporation of Stirling. This was the second Bill on the subject of gas legislation for Stirling which had occupied the attention of Parliament. The first was introduced by the Corporation to acquire the gas undertaking under an agreement with the Company. The scheme was strongly opposed by certain ratepayers; and the Bill did not pass. The question of purchase being disposed of in that way, the Company had now come to place themselves under parliamentary control; and the opposition was solely from the Corporation, who were in the position of rival traders, as they had taken up and were pushing the electric light. The existing capital was taken for the purposes of the Bill at £40,000. On this amount, £30,000 was taken as bearing 10 per cent. dividend, and the balance 5 per cent. The opponents wished that all the capital should be put at 5 per cent., which would be unreasonable. Power was asked to raise £10,000 additional working capital, which would also carry only 5 per cent. The advantages to the public under the Bill were that they would secure gas of not less than 22-candle illuminating power; while as to the price, it had been brought down to 3s. 4d. per 1000 cubic feet. From this the Company did not propose to depart. It was originally suggested to fix the standard price at 3s. 8d.; but, in the other House, as the result of the evidence of one of the witnesses, they agreed to reduce it to 3s. 6d. There would also be a sliding-scale, which gave the public an interest with the Company in the success of the undertaking. Yet, notwithstanding this, the Corporation were asking Parliament to throw out the Bill.

Mr. Blennerhassett (interposing) said the Corporation were not there to throw out the Bill, but to amend it in certain necessary particulars. If it were not so amended, they said it should be thrown out. The Bill should be altered in three particulars. In the first place, the petitioners said the capital was excessive, and imposed a heavy burden on the ratepayers; secondly, the standard price should be reduced; and, thirdly, the Corporation were anxious to preserve the rights of the ratepayers under the Burghs Gas Supply (Scotland) Act until next November, so that, if they wished to do so, they might decide as to putting the Act into force and buying out the Company, or, if the latter refused to be bought out, of starting a gas undertaking themselves. If the conditions as to capital, price, and ratepayers' rights were complied with, the petitioners did not object to the Bill going on. Of course, he could not give a pledge that in November the ratepayers would be in favour of purchase.

Mr. Balfour Browne having reiterated the conditions set forth by Mr. Blennerhassett, a suggestion was offered by the Chairman that there should be an adjournment, to afford an opportunity to the parties to settle their differences. Mr. Pembroke Stephens, however, said he thought it would be better for the Committee to hear the first witness, so that they might see how the case shaped.

Mr. D. Chrystal, the Company's Agent, then gave evidence on similar lines to that adduced before the Committee of the other House. In cross-examination thereon, he said the Company were willing to put into the Bill a clause providing that the dilapidations in their works should be made good by money taken from funds available for dividend. There were 7442 shares, on each of which £2 had been paid. The additions to the capital were got out of dividends; and in 1878 the £2 shares were changed into £4 shares, and so the nominal capital was increased in round numbers about £15,000. The witness was cross-examined at great length with reference to the negotiations which had taken place between the Corporation and the Company as to the acquisition of the gas undertaking, and as to the arbitration before Sheriff Lees, where the question was restricted as between a minimum sum to be paid of about £61,000 for the works, and a maximum sum of £69,000, which was the valuation put upon them by the Company's valuer. As the result of the arbitration, Sheriff Lees fixed the figure at £62,000 odd; and the then Corporation promoted a Bill to purchase the works for this sum. The Company stood aside, and left the Corporation to fight for the Bill as against the objecting ratepayers.

The Chairman intimated that the two points about which the Committee were anxious to agree were the price of gas and the amount of capital. After some consultation between the parties, it was agreed that the standard price should be fixed at 3s. 4d. per 1000 cubic feet, and the illuminating power of the gas at 25 candles.

The first point having been settled, Mr. J. A. Robertson was called to give evidence with respect to the second. He said he had gone through the books of the Company for the last 25 years, and had found that up to 1897 the capital expended had been a little over £30,000. Certain additions which had to be made in connection with the remodelling of the works brought the expenditure up to £39,678. The average dividend for the past ten years had been 8¾ per cent. On the 15th of May this year, after allowing for certain necessary outlays, the clear profit of the Company available for division was £3564. This showed an increase of profit on the sale of gas during the last few years; and he attributed it to better management and improved manufacturing processes. He thought the doubling of the capital was quite legitimate and justifiable.

Mr. J. Hepworth was the next witness. He said the Company's works could not possibly be better situated, being close to the railway station and in the centre of the town. The area of the site was 2½ acres; and it was large enough to enable the Company to double the quantity of gas now being manufactured. The present production was 389,000 cubic feet per day. The extension of the works now in progress would enable the Company to manufacture 700,000 cubic feet per 24 hours; but a retort-house was being constructed of sufficient size to permit of an increased production of a million cubic feet daily. The works were being extended in anticipation of an increasing consumption of gas in the district; and at the present rate of progress, the consumption would be doubled in 14 years. The additional expenditure of £5000 was being met entirely out of revenue; and when the improvements and extensions were completed, the whole of the plant and apparatus would be in first-rate condition. He estimated the structural value of the works at £41,474. It was proposed to fix the original capital of the Company at £40,000, which, in his opinion, was eminently fair and reasonable.

Mr. Corbet Woodall followed, and generally corroborated Mr. Hepworth's evidence; saying the proposals of the Bill were fair.

Mr. Balfour Browne then addressed the Committee on behalf of the Corporation.

When the Committee re-assembled on the morning of the 23rd ult., Mr. Pembroke Stephens, on behalf of the promoters, stated that he was authorized to say that the points in disagreement between the parties had been all settled with one exception, upon which he was to take the Committee's opinion. The promoters had believed on the preceding day that they had made good their case for a £30,000 10 per cent., and a £10,000 5 per cent. capital; but it had been arranged that morning that the capital should be £25,000 at 10 per cent., and £15,000 at 5 per cent. The matter still in dispute was whether the sum of £5000 paid for renewals of the works should be put to revenue or capital. Counsel submitted a clause on this subject; but the Corporation brought up an alternative proposal. Discussion ensued; but the Committee interfered, and decided to pass the Bill on the understanding that the 10 per cent. capital should be stated at £24,000, that the 5 per cent. capital should amount to £16,000, that the expenditure on repairs should come out of revenue, that the standard price of gas should be 3s. 4d. per 1000 cubic feet with the sliding-scale, and that the illuminating power should be 25 candles.

Thanet Gas Bill.—In the "Parliamentary Intelligence" in the two last issues of the "JOURNAL" further progress of this Bill was recorded. It will be remembered that, after passing the House of Commons, it was adversely reported upon by a Committee of the House of Lords. The Bill was, however, referred back, and was again considered by the Committee on the 10th ult. We learn that the Corporation of Margate, on whose opposition the Committee had decided that the Bill should not pass, agreed to the re-committal, on the understanding that the promoters would strike out the schedule as to lands, and practically abandon the clauses for the compulsory acquisition of land; this being in accordance with the representations they made at the first hearing as to possible contamination of the water supply by impurities percolating from the gas-works. Part of the arrangement between the promoters and the Corporation was that they should agree regarding another site for the erection of the works. No Counsel were engaged; the promoters being represented by their Parliamentary Agents (Messrs. R. W. Cooper and Sons) while Messrs. Sharpe and Sons, Parliamentary Agents, appeared on behalf of the Corporation. In addition to striking out the schedule as to land and the clauses as to the compulsory acquisition, the two following clauses were inserted: (31) "As from the 1st day of January, 1899, section 28 of the Act of 1877 shall be hereby repealed, and the prescribed number of candles shall be 15." (32) "The price charged for gas supplied to public lamps shall, as from the 1st day of September, 1898, be 5 per cent. less than the lowest price charged for the time being for gas supplied to private consumers." The Bill, as amended, was duly reported to the House, and read the third time; and, as notified to-day, it has now received the Royal Assent.

Reductions in Price.—The Muirkirk Gas Company have reduced the price of gas from 5s. to 4s. 7d., and the Galston Gas Company from 4s. 2d. to 3s. 9d. per 1000 cubic feet.

The Transfer of the Bakewell Gas-Works.—Last Friday, the Bakewell District Council took possession of the undertaking of the Gas Company, which they purchased at a cost of £11,522, of which sum £1200 was paid to the Duke of Rutland for his reversionary interest and freehold. At a special meeting of the Council on Thursday, a cheque was signed for £10,350. The money will be obtained from the Leeds Corporation on a 45 years' loan, repayable by half-yearly instalments of principal and interest at £3 2s. 6d. per cent.

LEGAL INTELLIGENCE.

COURT OF SESSION—FIRST DIVISION.

Saturday, June 25.

(*Before the* LORD PRESIDENT *and Lords* ADAM, M'LAREN, *and* KINNEAR).

Infringers of the Incandescent Gas Company's Patents Sent to Prison.

To-day judgment was given on a complaint presented by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, of breach of interdict against George Roberts, or Terry, of 97, Sauchiehall Street, and 19, Howard Street, Glasgow, and against Duncan M'Culloch, of 21, Gibson Street, Glasgow, in respect of the sale of infringing mantles. This matter was referred to in the "JOURNAL" for the 16th of November last (p. 1070), when application was made in the Bill Chamber of the Court of Session for an interim interdict against the above-named parties, and two others, named Felix and Munro. Lord Pearson granted it, and sent the case into the Court for trial. No appearances were made on behalf of the respondents; and the interdict was made perpetual. In January last the Company presented a note to the First Division of the Court, alleging that the parties had been guilty of a breach of the interdict by continuing the sale of the mantles complained of. When the case was called in February, interdict was made against Munro, with £7 7s. expenses; and Mr. Clyde, for the complainers, moved that proof be allowed as regarded the other respondents. Proof was led before Lord M'Laren on the 10th and 11th of May; and Counsel were heard upon the evidence on the 21st and 22nd ult. The respondents appeared for themselves, and denied that they had been guilty of infringement.

The LORD PRESIDENT, in giving the judgment of the Court, said: The question in the case of either respondent is whether, in knowledge that he had been interdicted from using the complainers' invention, he did nevertheless use it. There is no question as to the dates of service of the interdict. In the case of the respondent Terry, the service was personal; and it is impossible to avoid noticing that the circumstances of the service were such as did not augur well for the loyal observance of the interdict. In the case of M'Culloch, it has been maintained that he was absent from home when the interdict was served; that he was in Ireland; that the interdict only came to his knowledge after his return; and that one of the sales complained of took place in his absence. We do not think that this has been established. The contrary is *primâ facie* shown under his own handwriting; and the contrary was stated to the officer by those in charge of the house at the time of service, for the excuse then offered for his non-appearance was that he was ill and could not be seen. That, in the case of either respondent, the patented articles were sold after service of the interdict, at premises under his control and management, is clearly proved. The fact of the individual sales specifically spoken to by the witnesses, at the places named by them, cannot be doubted; and it is equally certain that the articles sold were of the kind to which the patent and the interdict related. The only question is as to the complicity of the respondents in those sales. Now, the evidence satisfies us that those sales were not isolated, casual, or inadvertent, but were parts and specimens of a system of dealing in the prohibited articles, at the several places named by the witnesses. It is true that the evidence is not copious; but this is not to be expected in a clandestine and illegal trade. The fact that after, as before, the interdict, the conductors of that trade have chosen to surround themselves and their business with a cloud of mystification and aliases is, of itself, evidence of dishonest trading. But the direct evidence reveals, with sufficient distinctness, the respondent Terry as controlling the business with which the witnesses associate him. And the fact that his saleswoman has not been produced as a witness is corroboration of that evidence. In like manner, the true relation of M'Culloch to the business which he now disclaims is adequately established, not only by the evidence adduced by the complainers, but also by that led by himself. While bound to take into account each part of the evidence, we have been careful, as the respondents were not represented by Counsel, not to rely on omissions or what might be mistakes. But we are unable to arrive at any other conclusion than that both and each of the respondents have, by themselves and through their employees, knowingly, intentionally, and systematically used this patent, after being interdicted from doing so. These violations of the specific orders of the Court call for effective punishment, and both respondents must go to prison for a month.

The case of Felix has still to be dealt with. A fresh interdict was applied for against Munro on the 22nd ult., and the Court ordered it to be served upon him, and allowed him eight days to lodge answers.

Manchester Corporation and their Gas Residual Products.—At the last meeting of the Committee of the Manchester and Salford Sanitary Association, Mr. W. Thomson, F.R.S. (Edin.) was requested to introduce at the next meeting of the Committee the subject of the manufacture of gas residual products, with a view to urging upon the Manchester Corporation the importance of undertaking this work themselves, both on financial grounds and with a view to having the operations conducted with up-to-date appliances, which would prevent the serious nuisances now the cause of so much complaint in Ancoats.

Tunbridge Wells Water-Works Extensions.—The Tunbridge Wells Town Council recently held a special meeting for the purpose of considering a report from the Water Committee recommending an application to the Local Government Board for a sum of £24,000 for filtration and other works in connection with the water supply. The Water Engineer (Mr. Mellor) had prepared a scheme for the filtration of the whole of the water supplied to the towns from the springs and boreholes at Pembury, and estimated the cost at £16,000, including the cost of the land. The Committee had submitted the scheme and estimate to Mr. J. Mansergh, who reported satisfactorily thereon. The Committee therefore recommended the Council to carry out the filtration scheme and incidental works—the latter at a cost of £8000; and to ask for sanction to borrow £24,000. Considerable discussion took place on the matter; but in the result the report was adopted.

MISCELLANEOUS NEWS.

THE INSPECTION OF GAS LIQUOR AND OTHER WORKS UNDER THE ALKALI ACTS.

The Sub-Inspectors' Reports.

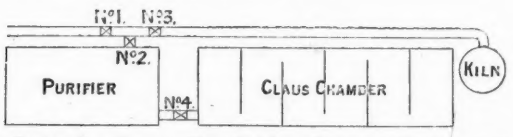
In the "JOURNAL" for the 7th ult., we noticed the report of the Chief Inspector under the Alkali, &c., Works Regulation Act (Mr. R. Forbes Carpenter) for the past year. We now give some extracts from the reports of the Sub-Inspectors.

Reporting upon Ireland, Mr. E. G. Ballard states that there was no addition to the number of sulphate of ammonia works to report. On the contrary, two ceased operations, and have not been again registered. The works were all carefully conducted; and no complaints arose. Taking all the places where sulphate of ammonia is manufactured in Ireland, the number of works absorbing the sulphuretted hydrogen in oxide of iron is 21; the number burning it, 5; the number working on the continuous system of distillation, 13; and the number working on the intermittent system, 13. There were 2740 tons of sulphate made in the district during the year. The works where tar is distilled were all carefully conducted; proper appliances for dealing with the noxious vapours evolved in the operations having been adopted. The works referred to in last year's report as needing more strict supervision on the part of the management have been much improved, and are now fairly well on a footing with others of this description.

Mr. Ballard also reports upon the district embracing Cheshire, North Wales, and part of Lancashire. He says there is not much change to report with regard to sulphate of ammonia works, except that one important place has abandoned burning the sulphuretted hydrogen in favour of absorbing it in oxide of iron; and for this purpose two good purifiers have been erected, with proper lute valves for changing the direction of the gases from one to the other as necessity requires. Taking all the works together, there are 18 working on the continuous system of distillation, and 5 on the intermittent system; 18 absorb the sulphuretted hydrogen in oxide of iron, 4 burn it either under the boiler fires or in the retort flues, and in one case it is converted into sulphur in a Claus kiln. The total quantity of sulphate manufactured in the district during the past year was 3285 tons.

Reporting upon the Widnes and Runcorn district, Dr. J. Affleck says the five plants belonging to sulphate and muriate of ammonia and gas liquor works remain almost exactly in the same condition as they were in a year ago. No extensions have taken place, but the existing apparatus has been well maintained, and is all in an efficient state. The sulphuretted hydrogen and other noxious gases evolved in these processes continue to be treated in the same way as described in previous reports, and have given no trouble. The joint production of ammonia salts in these works during 1897 was equivalent to about 900 tons of ammonium sulphate. Another sulphate of ammonia plant is at present in process of erection by the United Alkali Company, Limited, at Widnes, in connection with some new coking-ovens.

Mr. H. Porter, who has charge of the district comprising North and East Lancashire and part of Yorkshire, says there are now 12 liquor ammonia and 38 sulphate or muriate of ammonia works under his supervision. The total quantity of liquor distilled, equivalent to sulphate, last year was 15,220 tons; the proportion of distilled liquor ammonia being 1·45 per cent. The sulphuretted hydrogen evolved is dealt with by absorption in lime or oxide of iron (mostly by the latter) to the extent of 63 per cent. of the liquor distilled. Mention was made last year of the escape of the gases from the purifiers caused by the shrinking of the oxide from the sides or walls of these vessels. In two or three cases a projecting ledge has been built, in the case of brick purifiers, or a flange made with angle-iron in the case of iron ones, to baffle the gas; and since then no escapes have been noticed. Mr. Porter gives particulars of the death by suffocation of a man employed at the Colne Corporation Gas-Works while cleaning out the kiln of the Claus plant—a fatality which was noticed in the "JOURNAL" at the time. It appears that there was some obstruction to the passage of the sulphuretted hydrogen, and the Claus plant was stopped. The next day the gases from the saturator were turned into the oxide purifier attached to the Claus plant. Two men were told off to clean out the kiln, which was only 4 feet deep to the bars, and 2 ft. 9 in. in diameter. After the packing had been sufficiently removed, one of the men got into the kiln, and the other left the spot to fetch something—being absent only three or four minutes. On his return, he spoke to his mate. Receiving no answer, he went on to the top of the kiln, and found him insensible. All attempts to revive him were unavailing. At the inquest, no evidence was forthcoming to show how or what kind of gas had got into the kiln. The Engineer tested the kiln with lead-paper after the man had been removed, and found only a slight trace of sulphuretted hydrogen. In this case there was a weak point in the arrangement of the plant, on account of the number of valves to be handled and kept in order; and though in this instance the valves were afterwards found to be shut or opened in their proper order, Mr. Porter says there is always the risk that they are not properly shut. Being screw valves, any grit or dirt getting on the seating might prevent the valve from being perfectly closed, though it would appear to be so.



Mr. Porter gives the preceding sketch, and says: "To disconnect the Claus plant from the sulphate plant and connect the purifier, three of the four valves would have to be altered. No. 1 valve would remain open; No. 2, having been shut, would be opened; No. 3, having been open, would have to be shut; and No. 4, having been open, would also have to be shut. The change-valves that have been shown and explained in previous reports will safely fulfil the functions of all these four

valves by one movement; and being simply a water-joint, it can be seen at a glance if it is in proper condition or position. A drawing of one of these valves was sent to the Engineer, who replied that the valves in question should be altered."

Mr. Porter goes on to say that the value of having large and deep purifiers connected with the draught of a chimney in order to carry off the noxious gases while emptying, was strikingly shown lately at one works where such an arrangement exists. A purifier was being emptied, when two of the men employed were seriously inconvenienced by the presence of the gases. Investigation showed that the draught-pipe connecting the purifiers with the chimney had become blocked with fine dust—chiefly oxide—preventing the ventilation of the purifiers. At another works an additional purifier was fixed last year, and a three-way water-lute change-valve, of the kind mentioned above, attached, so as to be able to tell with certainty to which purifier the gas was going. At one or two works, the size of the purifiers being small in proportion to the plant, constant changing was necessary; and sometimes heating of the oxide and firing of the wooden grids was the result. Mr. Porter points out that purifier space would be cheaper in the long run. At the end of the year, there was a little more activity in the manufacture of sulphate; one or two works which had been making ammoniacal liquor having started producing the salt.

There was no addition to the tar works during last year. Unfortunately, there were three fatalities in connection with this class of works—two resulting from the explosion of a still, and one by gassing while cleaning out a still. The last occurred at the works of the Bury Corporation. Full particulars of these accidents are given. Mr. Porter says that a hard-and-fast rule ought to be made that no man should go into any still alone, or unwatched by someone ready to assist him at a moment's notice; and also that disconnection of the gas-pipe from other parts of the plant should be made to ensure that no gases can return.

The East Midland District is under the supervision of Mr. E. Morley Fletcher. It contains 27 works where sulphate or muriate of ammonia is made, and nine liquor ammonia works. The total quantity of ammoniacal products manufactured during the year amounted to 13,444 tons, calculated as sulphate of ammonia. The amount derived from coke-ovens was 945 tons. The manufacture was more active during the latter portion of the year, owing to the increase in the price of sulphate. There are 14 works where tar is distilled, and at all of them means have been adopted for dealing with the sulphuretted hydrogen and other uncondensable gases evolved during the process of distillation. The most general method in use is to draw off the gas from the oil receiver at the still-worm end, and to pass this through suitable condensers to the boiler fire, where the uncondensed gases are burnt. The greatest quantity of gas is evolved during the distillation over the anthracene; and tests were made in the chimneys and boiler flues at four of the larger works, in order to estimate the total amount of acid, calculated in terms of sulphur trioxide per cubic foot, escaping, and to determine whether any sulphuretted hydrogen passed away unburnt. None was found.

In the South Midland district, which is under the supervision of Mr. E. Jackson, the manufacture of sulphate, muriate, and carbonate of ammonia, as well as of anhydrous ammonia, and the concentration of gas liquor, are carried on in 79 works. The greater part of the liquor distilled is derived from ordinary gas-works. There were in operation last year five works where coal is carbonized for the condensable products and the coke. Recovery plant is also attached to two coke-oven works; and, in addition, plant for recovering products from blast-furnace gases is erected at two iron-works. One of these was in full work last year; but the second remained idle. A very fine additional Claus plant has been erected at one of the works in the district; and it has dealt with the sulphuretted hydrogen from 105 tons of sulphate of ammonia per week. Three new plants for the production of sulphate of ammonia were started in this district last year, in each case at gas-works; the method adopted for arresting the sulphuretted hydrogen being the oxide of iron purifier. At one works a very good plant was built for the production of a ton of sulphate of ammonia in 24 hours. The oxide of iron purifiers were arranged with change-valve, &c., for alternate revivification *in situ*. The total quantity of liquor distilled, expressed as sulphate, was 24,356 tons, 94·4 per cent. being treated by the continuous process, and 5·6 per cent. by the intermittent process. The sulphuretted hydrogen is dealt with mostly by oxide of iron or lime; but in two works, making altogether 155 tons of sulphate yearly, the combustion method is employed. At one of these works oxide purifiers have been erected, but not yet connected to the ammonia plant. At the other, the Claus process was adopted until an explosion in lighting up the kiln wrecked the sulphur chambers. In order to allow of the sulphate plant being worked until the chambers and kiln could be rebuilt, permission was granted for the sulphuretted hydrogen to be temporarily burnt in retort flues. The erection of the new plant was delayed, as it had been decided to build an entirely new sulphate works, provided with all the most recent improvements; and the sulphuretted hydrogen would be treated by the Claus process as before. Had it not been for these two works, the plan of burning the sulphuretted hydrogen and sending the resulting sulphurous acid into the chimney would have entirely disappeared from the district. The distillation of tar is carried on in 21 works; the methods described in previous reports for dealing with the gases escaping condensation at the worm being generally adopted.

The remaining reports will be noticed next week.

OPENING OF NEW GAS-WORKS FOR SEATON.

The ceremony of opening the gas-works which have recently been reconstructed for the Seaton Gas Company near the railway station in that town took place last Thursday, in the presence of a large gathering of townsmen and visitors. The new works comprise three settings of retorts (fourteen in all), with hydraulic and foul mains, and condensers; tower scrubber, 3 ft. 6 in. in diameter and 13 ft. 6 in. in length, on the Livesey principle; a gas-engine and exhauster; a purifier 12 feet square, worked in conjunction with two 6-feet purifiers; a station meter; a gasholder with cast-iron tank, having a capacity of 15,000 cubic feet; and new tar and liquor wells, having a capacity of 7000 gallons. A further contract has been entered into to lay larger mains in the town. New buildings have also been erected, including retort-houses, coal-stores, purifier and governor houses, and lime-stores. The works are now capable of producing 10 million cubic feet of gas per annum. The work of reconstruction has been carried out by Messrs. Willey and Co., of London and Exeter; all the apparatus having been specially designed by the Company's Engineer, Mr. Henry A. Willey, Assoc.M.Inst.C.E. The opening ceremony was performed by the Chairman (Mr. G. Evans), who turned the valve connecting the gasholder with the town mains. A vote of thanks having been accorded to him, the party were conducted over the works by Mr. Willey, who described the various portions of the plant. Subsequently, at his invitation those who had taken part in the proceedings had lunch together at the Beach Hotel, when the toast of "Success to the Seaton Gas Company," proposed by Mr. Willey, who presided, was heartily received. He also presented to Mr. Evans a silver soup-tureen, bearing a suitable inscription, as a memento of the occasion, Mr. Evans, in responding to the toast, thanked the Chairman for his very handsome and unexpected gift. As to the new gas-works, he believed their success was assured. Mr. Willey, and his father before him, had always had the complete confidence of the Directors in any work they had undertaken for them. Other toasts followed, and the proceedings closed.

NEW PUMPING-STATION FOR THE RAMSGATE CORPORATION WATER-WORKS.

Last Tuesday morning, at the invitation of the Mayor of Ramsgate (Mr. L. Hart), a party composed of members of the Corporation and their guests proceeded to the new pumping-station which has been erected at Whitehall, in connection with the municipal water-works, to the designs and under the supervision of the Gas and Water Engineer, Mr. W. A. Valon, and his son, Mr. Arthur Valon. The party left the Town Hall in carriages, and on arriving at the entrance to the new building a brief formal ceremony took place. The Mayor uncovered a brass tablet, bearing the following inscription: "Borough of Ramsgate Water Department. This building was completed A.D. 1898. L. Hart, Mayor; C. J. Gwyn, Chairman; W. A. Hubbard, Town Clerk; W. A. Valon and Son, Engineers." His Worship, in a few timely remarks, expressed the belief that the building, with the valuable machinery it contained, would be sufficient to meet the needs of the borough for many years to come. The party were then conducted over the building by the Engineer, assisted by Mr. A. Valon; the result of the inspection being a generally-expressed opinion that the station was one of the most complete of its kind.

The building is in three divisions, the centre one 63 feet by 59 feet, and 25 feet high. It is lined throughout with glazed bricks, and has an iron roof supported in the centre by cast-iron columns. The main building covers the machinery, which consists of an engine of 50-horse power nominal, working up to 90-horse power. This engine drives one set of 14-inch and another set of 12-inch deep-well pumps; or by changing the gearing it will pick up the new set of three 18-inch pumps, which have been put down in a well 12 feet in diameter, connected directly with the headings. There is also a 30-horse power (nominal) engine, working up to 50-horse power, driving a set of 14-inch deep-well pumps. Each of the three wells is sunk independently; but they are connected underground, at the level of the headings, by galleries. The wells are lighted by gas from top to bottom—an arrangement which minimizes the danger of lubricating and attending to the cranks and pump-rods, as well as facilitates the execution of any repairs that may be necessary from time to time. On the ground floor there has been placed a condenser, through which all the used steam from the large engine passes in brass pipes. The steam is effectually condensed by a jacket of cold water surrounding the pipes; the water being constantly maintained cold by passing some part of what is raised through the condenser. The air is withdrawn by a vacuum pump; the vacuum being kept steadily at 27 lbs. per square inch. This improvement abolishes the necessity of using the jet condenser worked by the engine itself, while it saves the loss of at least 60,000 gallons of fresh water per day. All the valves controlling the main supply pipes leading to the reservoirs are under cover; and the foreman in charge has within range of his vision the whole of the machinery for raising the water, as well as the valves controlling its issue from the pumps to the reservoirs. Adjoining the main building, and directly connected with it, is the boiler-house, 25 feet by 59 ft. 6 in. by 16 feet. Here two Lancashire boilers, 30 feet long by 7 ft. 6in. in diameter, have been set; the working pressure being 80 lbs. The boilers are worked alternately.

At the close of the inspection, the visitors partook of luncheon upon the premises. The Mayor presided; and Mr. Gwyn was in the vice-chair. Captain Vaile proposed "Prosperity to Ramsgate and Success to the Water Undertaking;" coupling with the toast the name of Mr. Gwyn, whose past and present services to the borough he warmly eulogized. This gentleman replied; and concluded by asking the company to drink to the health of the Engineer, who, he said, had been so intimately associated with all that made for the prosperity of the town. Mr. Valon, in responding, gave a description of the building and machinery. He said that under them as they sat there were two miles of pure water waiting to be pumped; and at the present time they could raise 1,250,000 gallons per day. He mentioned that while the general plans and the machinery were his own, the credit for the inside of the buildings belonged to his son; and Mr. Simmers had been Clerk of the Works. These young men had gained all their experience in the Corporation's workshops—they had, in fact, been pupils of the Corporation. In conclusion, Mr. Valon alluded to the Contractors (Messrs. Paramor), who, he said, had carried out their work in a most painstaking, efficient, and conscientious manner. Mr. Paramor, whose health, proposed by the Engineer, had been cordially drunk, responded. He mentioned that the firm proposed to ask the Mayor and Mr. Gwyn each to accept a silver key of the premises; and he suggested that the building should be thrown open for inspection by the ratepayers and the visitors at some stated hour once a week. The health of the Mayor was then proposed and responded to; and the proceedings closed.

THE SUPPLY OF ELECTRICAL ENERGY FROM CENTRAL GENERATING STATIONS.

Report of the Parliamentary Committee.

It may be remembered that, in view of the measures introduced by certain Companies this session for the supply of electrical energy from central generating stations, a Joint Committee of the Lords and Commons was appointed in March to deal with the matter, as the sanctioning of the proposals by Parliament would institute competition with existing undertakings. The members nominated by the Lords were Viscount Cross, Earl Spencer, Viscount Knutsford, and Lord Monkswell; the representatives of the House of Commons being Lord Balcarres, Sir Leonard Lyell, Mr. Ashton, and Mr. Kimber. The first meeting of the Committee was held on the 31st of March; and Viscount Cross was appointed Chairman. The Committee were to inquire—

1.—Whether, notwithstanding the provisions of section 12 (1) of the Electric Lighting Act, 1882, powers should be given in any cases for acquiring land compulsorily for generating stations; and, if so, under what conditions as respects liability for nuisance, notices to surrounding owners, and otherwise.

2.—Whether compulsory powers of acquiring land for generating stations, if proper to be given in any case, should be given where the proposed site is not within the area of supply.

3.—Whether, in case of a generating station, however acquired, not being situate within the area of supply, power should be given for the breaking up of streets between the generating station and the boundary of the area of supply.

4.—Whether powers should be given in any case for the supply of electrical energy over an area including districts of numerous local authorities, involving plant of exceptional dimensions and high voltage; and, if such powers may properly be given, whether any, and what, conditions should be imposed—(*a*) with respect to system and plant, and to the construction and location of generating stations, in view of the powers of purchase conferred upon local authorities by sections 2 and 3 of the Electric Lighting Act, 1888, and (*b*) with respect to the relations of the promoters to other undertakers and to local authorities within parts of the area.

5.—Under what conditions (if any) powers ought to be conferred upon promoters seeking to supply electrical energy to other undertakers, and not directly to consumers.

The sittings of the Committee extended, with intervals, till June 23, when their report was presented. They took evidence from Sir Courtenay Boyle, the Earl of Morley, the Hon. Chandos Leigh, Q.C., Mr. W. H. Preece, C.B. (Engineer-in-Chief and Electrician to the Post Office), and Major Cardew (Electrical Adviser to the Board of Trade); and they had before them Counsel representing the following bodies: Central Electric Supply Company, Limited; Chelsea Electricity Supply Company, Limited; General Power Distributing Company; Midland Electric Corporation for Power Distribution, Limited; House-to-House Electric Light Supply Company, Limited; Kensington and Knightsbridge Electric Lighting Company, Limited; London Electric Supply Corporation, Limited; County of London and Brush Provincial Electric Lighting Company, Limited; Westminster Electric Supply Company, Limited; the Corporations of Doncaster, Glasgow, Huddersfield, Ilkeston, Lincoln, Manchester, Nottingham, Retford, Rotherham, Salford, Sheffield, and Wolverhampton; and the London County Council. The Corporation of Edinburgh and the Metropolitan Electric Supply Company were represented before the Committee by their Parliamentary Agents.

The several Bills pending in Parliament in which effect was proposed to be given to new developments of the electrical industry were brought to the notice of the Committee; but they did not consider them in detail, or take any evidence upon them. They treated them only incidentally, as showing the lines upon which the industry was likely to expand. They laid down the general principles which they suggested should guide Parliament and the Board of Trade; but whether those principles should be applied in whole or in part, and whether any, and what special conditions should be imposed, they left to be decided in each individual case according to its merits. They heard all the witnesses tendered by the several parties, and agreed upon the following answers to the questions referred to them:—

Question 1.

(*a*) The proved public advantages of electrical energy in the generation of light and power warrant, in their opinion, the granting to undertakers of compulsory powers for acquiring sites for generating stations, and lands or easements for pipes and mains therefrom, and other works.

(*b*) Provision should be made for the granting of these powers in the Provisional Orders of the Board of Trade, subject to confirmation by Parliament. Such provision would facilitate a continuance of the existing practice according to which more or less uniform conditions under which undertakers are to work are provisionally settled by the Board of Trade. Procedure by Private Bill should be reserved, as at present, for exceptional cases.

(*c*) Such powers may be given either to local authorities or to incorporated companies, whether the incorporation be by Special Act or Provisional Order or under the Companies Acts.

(*d*) With respect to liability for nuisance, they are of opinion that where the site for a generating station is acquired under compulsory powers, and is specified in the Provisional Order or Special Act, the undertakers should not be subjected to any further liability than that which, according to Lord Blackburn in *Geddis v. Bann Reservoir* (3 App. Cases, 455),* is imposed by the common law in the case of persons exercising statutory powers and duties. On the other hand, where the site for a generating station is acquired by agreement, they think the undertakers ought to be subject to the liability imposed by the common law.

(*e*) With respect to notices, they think that the existing practice as to notices to the local authorities, and also to owners, lessees, and occupiers of lands proposed to be taken, should be followed. With respect to notices in the "Gazettes" and newspapers, they do not suggest any amendment of the existing procedure. The amendment of the Electric Lighting Acts necessary to empower the Board of Trade to grant compulsory powers will, they assume, comprise provisions for notices and other matters of procedure, for which precedents are found in the Housing of the Working Classes Act, 1890, and in the Light Railways Act, 1896.

Question 2.

Subject to the above observations, the Committee are of opinion that compulsory powers for the acquisition of land for a generating station, and lands or easements for pipes and mains and other works to the area of supply, may also properly be given where the proposed site is not within the area of supply. The local authorities for the district or districts in which the site is, and the owners, lessees, and occupiers, should have the same notices and the same *locus standi* as if that district were the area of supply. Provision also should be made for serving notices to local authorities and owners, &c., of districts or land through whose districts or land mains are to be run from the generating station to the area or areas of supply.

Question 3.

In the case of powers being given for the erection of a generating station outside the area of supply, they think that powers may properly be given for laying the mains in streets leading from the generating station to the boundaries of the area of supply. In such case, the local authority liable to maintain these streets should have the same option of themselves breaking up and reinstating the streets at the undertakers' expense as is now given in the Provisional Orders to local authorities within the area of supply, and should be empowered accordingly.

The Committee are of opinion that, while it may be advisable to maintain the veto of local authorities as to the erection of overhead wires, given by section 14 of the Act of 1882, in respect of other electric wires, it is not advisable that in the case of overhead wires for traction purposes the local authority, other than the London County Council and county boroughs, should have an absolute veto. While due weight should be given by the Board of Trade to the representations of local authorities, the Committee think that in the case of wires for the purposes of traction it would be sufficient to give a *locus standi* to such local authorities.

Questions 4 *and* 5.

Where sufficient public advantage is shown, powers may be given for the supply of electrical energy over an area including districts of numerous local authorities, and involving plant of exceptional dimensions and high voltage. The Committee further think that undertakings of this character may properly be authorized on conditions differing in some respects from those imposed by and under the existing Acts.

Among the undertakers referred to in the preceding paragraph will be found undertakers supplying energy chiefly in bulk, or wholesale to other undertakers, whether local authorities or companies, whose areas of supply are wholly or partly within the area of such bulk or wholesale supplying company, and who distribute the energy so obtained to consumers.

As to giving compulsory powers of purchase of undertakings to local authorities, the Committee, without questioning the policy of Parliament in having given such powers, observe: First, that when the power of purchase was granted in 1882 and 1888, no such schemes of supplying energy in bulk were contemplated as are now before Parliament. Secondly, that when the power of purchase was thus granted, the question then before Parliament was chiefly one of light; whereas the evidence given before the Committee shows that, although electric light is at present the predominant feature of the enterprises now before the public and Parliament, the application of electrical energy in the form of power to an infinite variety of other purposes is likely to be in the near future the predominant feature and function of these undertakings. Thirdly, it does not appear to them that an undertaking supplying energy in bulk at high voltage, and in comparatively few mains, is, as a rule, so desirable for a local authority to acquire as a low-voltage undertaking with many distributing mains.

The Committee think the provisions of the Electric Lighting Act, 1888, enabling the local authority to purchase an undertaking after a term of years, inapplicable, as a general rule, to the case of an undertaker supplying energy in bulk at high voltage; but there may be special cases where it is desirable that the local authorities should have the right to purchase reserved to them. To meet such cases, they suggest that the Board of Trade should have power to insert the purchase clause in the Provisional Order, if the local authorities concerned can, in the opinion of the Board, show good cause for such a course.

It is to be observed that the exemption from liability to compulsory purchase would not prevent local authorities, either alone or in combination with other local authorities, from applying for powers to purchase; but each case would have to be judged on its merits, and such conditions imposed as might be thought fit. In cases of the exemption from liability to purchase, it would be specially expedient, in the interest of the consumers, that some kind of sliding-scale, as in the case of gas undertakings, should be imposed.

In connection with this question of purchase under section 2 of the Act of 1888, evidence has been given to the effect that, with a view to secure in London one and the same time for the execution of the powers, the Board of Trade have in some cases imposed upon undertakers a less term than 42 years within which they are liable to be purchased. The Committee suggest that, if the full period of 42 years is not granted, and if a substantially shorter period is imposed by the Board of Trade, the terms of purchase should in each case be reconsidered.

The Committee consider that the provisions of the Electric Lighting Act, 1888, which require the consent of the local authority as a condition precedent to the granting of a Provisional Order should be amended. In their opinion, the local authority should be entitled to be heard

* Lord Blackburn's opinion is in these words: "It is now thoroughly well established that no action will lie for doing that which the Legislature has authorized, if it be done without negligence, although it does occasion damage to anyone; but an action does lie for doing that which the Legislature has authorized, if it be done negligently. And I think that if, by a reasonable exercise of the powers either given by statute to the promoters or which they have at common law, the damage could be prevented, it is, within this rule, negligence not to make such reasonable use of their powers."

before the Board of Trade, but should not have, so to speak, a provisional veto, only to be dispensed with in special cases by the Board of Trade.

With respect to conditions, the Committee think it reasonable that where a local authority or company, having power to supply light within a certain area of supply, seeks to obtain compulsorily land for a generating station outside that area, it should not be allowed, except where Parliament or the Board of Trade decide otherwise, to supply from that generating station any area outside the area of supply of such authority or company.

With regard to the powers of purchase conferred by section 2 of the Act of 1888, they are of opinion that local authorities should be empowered to purchase undertakings partly outside their area of supply on terms agreed upon by the Board of Trade.

Provisional Orders.

The ordinary clause which forbids any connection with the earth, except with the approval of the Board of Trade and the concurrence of the Postmaster-General, should be inserted in every case.

As to protection of telegraphs and telephones, the clauses now inserted in Provisional Orders seem to be sufficient in all ordinary cases; and regulations to protect the public can be made by the Board of Trade under section 6 of the Act of 1882.

The clauses which protect gas and water pipes have worked satisfactorily, and should be continued; but the Committee would direct attention to the observations of Mr. Preece as regards the difficulty arising from the working of tramways by trolley wires. His suggestion as to a strong "control clause" should be carefully considered.

They are disposed to concur generally with Lord Morley and Sir C. Boyle in thinking that, as compulsory powers are given solely for the benefit of the public, it would be desirable to make some provision against these companies being subject to foreclosure on mortgage, and against their rolling stock and plant being liable to distress.

ELECTRIC LIGHTING NOTES.

The public installation of electric lighting on the front of Morecambe took place last Wednesday night, when 55 arc lamps from East View to West End Pier were lit. The estimated cost of the entire undertaking is about £40,000.

Professor Fleming has reported to the Douglas Town Council on the question of an electric lighting scheme for the borough. He estimates the initial outlay on an installation sufficient for the needs of the borough at £25,000, with a possible addition of £5000 for land. He suggests that in the first instance only the promenades and principal thoroughfares should be electrically lighted, and that the light should be gradually extended to the other streets.

The result of the recent confirmation of the Electric Lighting Orders for Marylebone and Bermondsey by the House of Commons, to which reference was made in our "Electric Lighting Memoranda" on the 21st ult., was a fall in the prices of shares. This will be seen from the following figures, taken from "London":—

Company.	Price, June 13.		Price, June 20.
Charing Cross and Strand	12¼—13	..	11½—12½
Chelsea	8¼— 9¼	..	7½— 8½
City of London	26¾—27¼	..	24½—25½
House-to-House	9 — 9½	..	7½— 8½
Metropolitan	16¼—16¾	..	13 —14
Notting Hill	18 —19	..	15 —16
St. James's and Pall Mall	16¼—16¾	..	14½—15½
Westminster	15½—16½	..	13 —14

It will be noticed that the Metropolitan Company, which was the one chiefly concerned, was affected less than some of the others.

A largely attended meeting of ratepayers was recently held at Blackpool to protest against the expenditure by the Corporation of another £40,000 on works for the supply of electricity. Mr. Rowarth proposed a motion to this effect; and it was seconded by Mr. Howarth. In doing so, he dealt at length with the financial position of the Corporation. He said that last year it required £76,000 to keep the town going—an increase of £10,676—exclusive of expenditure on capital account. That expenditure last year amounted to £120,000, so that the town then got rid of £196,000. The electricity works capital account was £132,830, or £221 per head of the consumers. He condemned the proceedings of the Electrical Committee, and mentioned that in one part of the town, where long cables had been laid, only two councillors and three officials took the current. The Chairman (Mr. Donnelly) criticized the charges made for electricity, and said the recently adopted system meant an increase of 50 per cent. to shopkeepers. They were 40 per cent. in excess of the prices in other large towns, and this notwithstanding Blackpool's favourable position. The motion was carried, as was also one condemning the adoption of the overhead system for tramways as being dangerous, unsightly, and unsuited to a health and pleasure resort.

The works which have for some months been in progress with the object of converting the old Town Mill, in the centre of Salisbury, into an establishment for the generation of electricity by means of water power, were brought into use for the first time on the 22nd ult., though they have not yet been formally opened. The service is in the hands of the Salisbury Electric Light and Supply Company, whose Engineer and Manager is Mr. L. A. Hands. The turbine at present in use for working the dynamos is of 70-horse power, and is capable of supplying 1500 lamps alight at one time, or, by storage, an additional 1500, for the average lighting required during the year. The battery, which weighs about 29 tons, is large enough to supply 1000 lights for nine hours or 1500 lights for four hours. It contains 230 cells. The system of distribution is the low-tension three-wire, with an initial pressure of 420 volts, and 210 volts to individual consumers. The mains are supplied from the station by two feeders, of triple concentric type, connected to two junction-boxes. In the general scheme of the works, the provision made is based upon the assumption that the number of 8-candle lamps required in the compulsory area will not exceed 6000, with a maximum load of about three-fifths of the total number of lamps installed. The mains laid down are large enough for supplying this load, though for some time to come it is not likely that so many lights will be taken up.

METROPOLITAN WATER SUPPLY COMMISSION.

Twenty-seventh Day—Monday, June 27.

(*Viscount* LLANDAFF, *Chairman*, *Sir* JOHN E. DORINGTON, Bart., M.P., *Sir* G. B. BRUCE, M.Inst.C.E., *Major-General* A. DE COURCY SCOTT, R.E., *Rt. Hon.* J. W. MELLOR, Q.C., M.P., *Mr.* A. DE BOCK PORTER, C.B., *and Mr.* R. LEWIS.)

The sitting took place at the Guildhall, Westminster.

The following Counsel are engaged: Mr. POPE, Q.C., and Mr. CLAUDE BAGGALLAY, Q.C., for the New River Company; Mr. LITTLER, Q.C., and Mr. LEWIS COWARD for the Kent Water Company; Mr. PEMBER, Q.C., for the Lambeth, East London, Grand Junction, and West Middlesex Water Companies; Mr. RICKARDS for the Chelsea Water Company; Lord R. CECIL for the Hertfordshire County Council; Sir JOSEPH LEESE, Q.C., M.P., for the Kent County Council and Kent Local Authorities; Mr. BALFOUR BROWNE, Q.C., and Mr. FREEMAN, Q.C., for the London County Council; Sir R. NICHOLSON for the Middlesex County Council; and Mr. GABRIEL P. GOLDNEY (Remembrancer) for the Corporation of the City of London. The Southwark and Vauxhall Water Company are represented by Messrs. BIRCHAM AND CO.

Mr. *James Bigwood*, M.P., Alderman of the Middlesex County Council, and Chairman of the Parliamentary Committee of the Council, examined by the CHAIRMAN, said the three Metropolitan Companies supplying in Middlesex were the West Middlesex, the New River, and the Grand Junction. The East London Company had power to supply in the county, but only to a very limited extent. Excluding the Thames, the only Company drawing water from Middlesex sources—wells—was the New River Company. It was a question whether the New River Company had a statutory right to the water. He had always understood that the Company drew the water from the wells as landowners. Middlesex had always consistently desired to stand independent of London with regard to the question of the water supply; and they had petitioned against the various Bills which the London County Council had introduced. There was a conference in May, 1891, between the London County Council and the various Outside Authorities, at which heads of discussion were submitted by the London County Council. The needs of Middlesex put forward there were that no scheme would be acceptable to Middlesex which did not provide for no further water being abstracted from the Middlesex supply; which did not give independent control from the beginning to Middlesex of their sources of supply and of their service; and which did not provide for the absolute non-interference with Middlesex, either as to rating or otherwise. Middlesex pleaded for non-interference; that was their strong point. They were satisfied with matters as they stood. Witness was strongly in favour of the maintenance of the *status quo*, subject to some further control on behalf of the Local Authorities. The principal objection of Middlesex to the main proposal of the London County Council—viz., for the provincial system to be applied to London—was that they had no confidence in the Council as a Water Authority. The constitution of the London County Council demanded so much time from the members, that it seemed to be hardly possible they would be able to devote proper attention to the work of such an important body as this would be. Then the Water Authority should be composed of much more independent men than a member of the County Council, or even a member of Parliament, would be; seeing that he had to pay so much regard to the wishes of his constituents.

The CHAIRMAN: I presume Middlesex feels there is a probability of large outlay in the future, in adding to the sources of supply.

Witness: Yes.

And that you have as much in your own county as you want for yourselves?—I think so.

And you do not wish to be saddled with the expense of going to Wales?—Quite so; and we do not want to see our rates increased. I have always held we have a prior right to the water of the Thames.

Mr. MELLOR: If you carry that out, every county as you go up the river has a prior right?

Witness: Yes; but the Thames is sufficient, and to spare. My view is that a large quantity of water flows to waste which might be stored.

The CHAIRMAN: If Middlesex goes on growing as it does now, and claims to be supplied first from the Thames, there will not be much Thames left for London?

Witness: It may be so; but that is London's look out.

Middlesex objects also to having any other county authority the Water Authority for Middlesex?—Very strongly. The interests of the county require that provision should be made against the sinking of new, or the deepening of existing, wells in the county, and for limiting the abstraction of water for London or any other external supply from Middlesex. The fact that the New River Company have surreptitiously sunk wells as landowners, shows that the other Companies might seek to do the same.

Mr. MELLOR: Your proposition is that Middlesex is entitled to all the water which lies underneath its soil.

Witness: Yes; that is my view. Middlesex objects to purchase by the London County Council, even if Middlesex should retain the sources of supply and distribution in their county.

Do you object to purchase by any other body whatever?—No; I do not think we do.

To substituting one managing body for the eight Companies?—I do not think it would be so popular.

Would you not get a chance of equalizing rates with a public Trust?—Yes; but we are quite satisfied with our rates at the present moment. I think Middlesex, in her own soil, supplemented by some water from the Thames, has an ample supply for the future. We do not object to more wells being sunk, except for use by an Outside Authority.

Mr. LEWES: Hertfordshire contends that sinking wells would be a very bad thing for the county generally?

Witness: I have heard that view; but I believe it is contradicted by experts.

Sir J. DORINGTON: Middlesex is pretty well covered by Companies?

Witness: Yes; fairly well. I have heard that there are certain portions outside the limits of supply of any Company; but those parts are very small. According to Middlesex ideas, there is no reason why, if purchase by the

London County Council took place, only so much of the West Middlesex Company's undertaking as applied to London should not be acquired; the remainder being left in the hands of the Company for the supply of Middlesex. There would be no difficulty about the severance of the works. Middlesex is anxious not to see its water sold to other districts, as is the case now; and they wish to be placed, in regard to an increase of water derived from the county, in a position of priority. On a transfer of the Company to a Central Authority, the county would be wise to make the best arrangement they could for themselves.

Mr. De Bock Porter: Do you not want to get a preferential claim which you have not at the present time?

Witness: No; I do not go so far as that. We are content with the present position.

The Chairman: Why should you be dissatisfied with a change which alters only the owner of the existing rights?

Witness: Because we fear that the new owner will make greater demands on what we consider to be our water, than is the case now.

The Chairman: The greater demand will only be made because there are greater wants.

Major-General Scott: And the Companies would adopt the same policy. If they wanted more, they would take more.

Witness: They would only take what their statutory powers enabled them to take.

The Chairman: They could sink more wells.

Lord R. Cecil pointed out that, as regarded wells, they were limited, to some extent at least, by the necessity of raising capital, for which the permission of Parliament was necessary.

Witness (continuing) said Middlesex had no desire to be a Water Authority, and would rather continue to be supplied by the West Middlesex Company.

The Chairman: What would be left for London, with its five million people, if every county claimed the exclusive right to its own water?

Witness: Then London would have to go to Wales.

Then that is the plain English of it. You wish to throw the cost of fetching water from a distance on London alone?—I think we do.

Would not Wales have a stronger right to object to the transfer of water from itself to London, than even Kent, Middlesex, or Surrey?—There would be the difference that Wales would be paid for its water.

What *quid pro quo* would they obtain that landowners in Middlesex would not get it if the Company secured additional powers of sinking wells in Middlesex?—I do not know how that is. We have prevented the Southwark and Vauxhall Company from getting any further sinking powers in Middlesex.

In answer to further questions, witness said that if Middlesex was supplied in bulk by the London County Council, one objection was that, being an outside area, they would be liable to be charged more than was paid inside; and in support of this, he put in a table giving nineteen instances where extra charges were made to outside districts. On the subject of control, witness said Middlesex desired it in order to ensure Middlesex water for Middlesex; and, still more, to secure a sufficient and efficient supply for all consumers. His present view was that the Companies should be under the control of some Government Authority, with representatives of the Local Authorities and of the Water Companies added. But the Government Department should outweigh the others. He did not see why London should be more fully represented than anyone else. He believed there was enormous waste going on now; and he would give the body stringent powers to prevent this. The Board might also have power to insist on greater enonomy in the administration of the Companies—such economy as would result from amalgamation. He had not considered how this was to be done. He merely suggested that there should be some authority over and above the Water Companies which should control them, and which would be readily available also to the consumers. Witness was rather closely questioned as to what the position of this body, its duties, powers, and constitution, were to be; but he returned very indefinite answers. It was suggested that, to a large extent, if not entirely, the matters mentioned were already met by the law. He held, however, that there were many small points on which they wished redress, and yet which were too small to warrant the existing slow and costly machinery being set in motion. Since the Act of last year, the Companies had been doing their duty much more satisfactorily. One thing which might be within the purview of the proposed Board would be the case of a Local Authority proposing to lower the level of a road, without regard to the pipes below; so that when frosty weather set in, the water in the pipes was frozen. The Board might then step in and say the road must not be lowered, or take the matter to arbitration. Another case would be the breaking up of a road by a Company to lay a main, immediately after the road had been made up by the Local Authority.

The Chairman: How are the decrees of this Board to be enforced? The present system is to make the Local Authority the champion of the consumer, if he had a grievance—to go before the tribunal, and collect penalties, and so to redress the grievance. You complain of this, and want to substitute a Board of Control. This Board must have powers to enforce their decrees; and I want to know whether you are going to give them arbitrary powers of distress, or fine, or imprisonment, or what?

Witness: I say that is a question Parliament should decide. All I advocate is that there should be an easy and simple method, by application to a tribunal or officer, for straightway settling disputes between any Water Company and a consumer.

Would you give this Board of Control any power over back-dividends of the Water Companies?—Yes; I should put them in much the same position as the Gas Companies are at present. I should say 10 per cent. should be the maximum dividend that should be allowed. As to back-dividends, I should allow (say) three years.

You would do this without any *quid pro quo* to the Companies?—Yes. I should also give power to deal with charges, where they were excessive or too small, even though they might be in accordance with the law.

What management is left to the Companies? You give the Board power of checking waste by the consumer, the duty of seeing after the supply by the Companies, power of charge, and the extent of dividends to be paid?—That leaves them to conduct their business.

The Chairman: Not much of it.

Mr. Mellor: Would it not be better for the Companies to be bought up than to have such control?

Witness: It might be.

The Chairman: Your Board would have power to overrule and alter every Act that has been passed relating to water.

Witness: No; I think the Board would have power to adjust the differences that occur in spite of every law that has been passed. An alternative system of control would be to give more power to the County Councils as to checking waste, and directing that any scheme for the extension, improvement, or adjustment of the Companies' works should be laid before the County Councils.

By Mr. H. L. Cripps (representing the London County Council): He wanted first to provide that no more wells should be sunk in Middlesex, and that those existing should not be deepened. He denied that the Companies had power now to do this. The New River Company had done so; but he had always thought it was *ultra vires*. He agreed with the London County Council that it was extremely desirable to settle this question as soon as possible. At present he thought no Londoner had an adequate supply of water; the consumption per head should be much greater. He really thought a solution on the basis of a Joint Board was practicable.

In reply to the Chairman, Mr. Cripps said the scheme of the County Council had been always that, if purchase by them took place and a rate-in-aid was necessary, it should not be levied on the outer districts taking water in bulk.

Mr. Lewis Coward (to witness): Why should not the Water Companies have similar rights to those which a private individual has as regards sinking wells?

Witness: Private individuals do it to supply their own requirements; the Water Companies do it to sell again. The Company with which I am connected have sunk a well, and sold the water to the public in the form of vinegar; and, putting the matter in this way, I see no reason why the same measure should not be dealt out to all the Companies. Any figure of three years as the limit for back-dividends is the result of a general survey of the whole situation as a business man.

By Lord R. Cecil: One objection to purchase by the London County Council was that Middlesex, in opposing a scheme of the Council, would find it more difficult than if the adversary were merely a Company. Moreover, if London was the purchaser, it would be able to take all the water of Middlesex and sell it to other parts of the Metropolis; so that all London might be sucking at that source.

Mr. *E. J. Halsey*, the Chairman of the Surrey County Council, was called, and examined by the Chairman. He said Surrey had always opposed any scheme which would place the county under the control of the London County Council, and had always insisted on having the sources of supply, as well as the means of distribution, in their own hands.

The Chairman: And to this the London County Council have very liberally agreed. Have you considered at all the practical difficulties there might be in separating existing sources of supply between London and Surrey?

Witness: We were sufficiently satisfied by the London County Council that the thing—if done in a friendly way—was possible, that we left it in that shape, the more so as the agreement with London was an option. We had two years to prepare our option. During those two years, we should have made our own investigations and decided as to whether the option we had got was worth taking up. We had not gone minutely, or from an engineering point of view, into the point of severance; but we have taken it that between two friendly bodies it was possible. In any circumstances, severance need not be so very difficult. What we wanted primarily was the sources of supply. The distribution pipes, of course, were saleable to us; being of no use to anyone else. We were contemplating that, having the water, we should need pumps and filter-beds of our own—not purchasing that part of the undertaking from London. Difficulties have been raised regarding the mains that come through Surrey—what main we were to have, and what main was to be left to London. This was always present to our mind; but we felt it was possible for us to have a main of our own, and not to purchase it from the London County Council.

Did it occur to you that there are only certain existing statutory powers of taking water from the Thames, and that you might get only a share of that, or nothing?—We had secured the statutory right to take water from the Thames; the question was whether we should not very readily obtain powers to put down another pipe to carry the water. Surrey was to have, under the agreement with the London County Council, as much as their existing supply, *plus* 20 per cent. For the future they contended that they had sufficient in their own county.

In the Thames?—If Parliament allowed water to be taken from the Thames, we should no doubt have secured our share; but even if Parliament had not allowed any more to be taken, we hold, and are advised, that there is sufficient water in our own borders. No detailed study of this matter has, however, been made.

What you opened out is of great importance in our view. Who was to have these new supplies from underground Surrey?—We should certainly come to Parliament to legalize the position—to create the Council a Water Authority. The Surrey Council reckoned on spending money, chargeable to a particular area, for procuring a further supply.

Then you, like Middlesex, think you need never trouble yourselves about a reservoir scheme or a Welsh scheme?—We do not wish to be saddled with it. By the Act of 1888, all Suburban Surrey was taken into the County of London. We were made, or supposed to be made, a rural county; and we wish to be what Parliament made us—a county complete in ourselves, without any dependence on London. Having a water supply of our own, we are content to supply our own population in our own way, and at our own cost.

Where are your supplies?—There are large supplies in the chalk, on the downs that run through Surrey; and there are also large supplies in the lower greensand. I do not think the London County Council would oppose Surrey in sinking wells, because apparently the quantity Surrey would require was not one that was likely to be of any great value to London. With reference to the Metropolitan Water Counties Bill, which the Government introduced in 1896, a meeting of representatives of the Metropolitan County Councils was held, at which a resolution was passed to the effect that the interests of London and of the other surrounding Authorities were so divided as to make the constitution of the Board proposed impracticable, without injustice to the several areas concerned.

Why was the Water Board impracticable without injustice?—In the first place, it is absolutely impossible that there should be a Water Board without London being the predominant partner. It seems to me to be manifestly unfair that London, with its large population and its large consumption of water, should not have a distinct and definite majority upon the Board. If it were not a numerical majority, it would always act as one man; and it would be difficult to get the other counties to act in the same way. Moreover, London might often get one or two other counties to join with it; and this would place the others at a great disadvantage. Surrey would be in a small minority; and in case of disagreement and (say) an application to a Parliamentary Committee, they would be told that they were a minority, and must suffer as minorities always had to. Again, suppose the Water Board went to Wales, and the water was found to be so admirable and good and superior to every other water in London, he should say: "Let us have a share of it; don't palm the Thames water off on us." But they would have to take their chance; and having paid for the Welsh water, they might never get it.

Cannot you imagine a Water Board which should be perfectly fair to everybody?—No, I cannot.

I will suggest—but not as recommending—a Board on which each county should have two members, London, if you please, four, with representatives of the Board of Trade, the Local Government Board, the Thames Conservancy, and other Government Departments possibly, and experts selected by a Government Department. Why should not such a Board do justice to your county?—Such a Board would wish to be fair; but I should have thought that would be a most extravagant way of managing the Metropolitan Water Supply. If the London County Council were the Water Authority, Surrey would be perfectly satisfied with the protection Parliament would give if Surrey opposed any proposal—just as they were satisfied with the protection they had from a Parliamentary Committee when opposing a proposal of a Company; but if Surrey was a unit in a large body, they might suffer very materially.

Mr. De Bock Porter: Is Surrey satisfied with the *status quo*?

Witness: The Surrey County Council have never lifted their little finger towards the purchase of the Companies by the London County Council. I cannot say Surrey is entirely satisfied with the Water Companies, for it is not. But, upon the whole, we feel that when more experience has been had of the working of the Act of last year, we may be able to remedy the difficulties that at present exist—the more so when (I am almost afraid to use the word) there is more control.

The Chairman: Have your County Council had any applications under the Act of last year?

Witness: One; but it has not been before us long enough for us to do anything. I do not like the Act much myself. I think going before the Railway Commissioners is a laborious and expensive process. A great deal of the friction between consumers and the Board of Trade would be obviated by a department of the Local Government Board and the Board of Trade, to which both parties could go with the conviction that they were going before an authority that was absolutely impartial.

On being pressed to give examples of the kind of difficulties at present existing, witness read a letter from the Kingston Corporation, in which was mentioned the hours of supply, the services of turncocks for fires, charges for water for road watering, purity of water, depth of mains in the roads, disturbance of roads, and control. In the charges of the two principal Companies in South London there was a considerable difference. He would advocate one uniform charge, arrived at by reducing the highest and raising the lowest rates. Regarding purchase, no resolution had ever been passed by Surrey that it was not desirable; but it was the general feeling that, subject to certain alterations in the form of control, it would be as well to leave things as they were. The Companies were doing their work well; they were amenable to argument; and there was no great reason to be dissatisfied with them. A conference was held in October, 1897, at which Surrey, Kent, and Croydon were represented. It was there decided that, if purchase took place, each county should have control of its own works, and much greater power of control both as to quantity and quality. He thought it would be an advantage to have a public officer connected with the Local Government Board, who might be called in to try and settle disputes before they went before the Railway Commissioners under the Act of last year. A little judicious management by an experienced official of the Local Government Board, known to have no interest except to do what was right and proper, would be very beneficial to all parties. Such a case might come before this official as the breaking up by a Company of a road to lay a main; the main being improperly laid, the road made up again, and the road having to be again broken up for the main to be properly laid. This actually occurred in one instance; and the road was nearly impassable for a year. The official should have power to support an application to the Railway Commissioners for pecuniary penalties. With regard to the making of uniform charges in Surrey, the reduction would be spread over a much larger area, and over a much larger population, than the increase.

The Chairman: It is not very unfair that the man who lives at the top of Wimbledon—which is a very high part—should pay a little more for his water than the man who lives near to the banks of the Thames?

Witness: Certainly not.

By Mr. Pember: As I understand, you would not give the official of the Local Government Board power to come to any decision against one of the two parties who may be brought before him?

Witness: I cannot very well say that I should now, because of the Act of last year. If the Act had not been passed, I would have done so. The official would be used as a go-between.

Is that not rather interposing an intermediate tribunal, and wasting time?—No; I think it would save a great deal of time. I prefer the antecedent chance of conciliation, to the present remedies of proceeding to law—of going to a Magistrate and taking out a shilling summons.

Major-General Scott: Do you desire that the Local Authority should have power of inspection of the works of the Company in any form?

Witness: I am afraid I have not had experience enough to say.

The Chairman: You have no officer who would be competent to inspect?

Witness: Oh, yes; we have the Medical Officer of Health.

But not to say whether the distribution pipes, and so on, were sufficient?—Well, the County Surveyor could, up to a point.

By Mr. H. L. Cripps: Surrey had a good deal of water in the Wandle, Mole, and Wey, and also in the chalk.

Mr. Cripps: From rural Surrey, you might be able, if it were necessary, to obtain from these sources, or some of them, a sufficient supply to meet your requirements?

Witness: Yes. But if a joint body, representing the whole Metropolitan area, or the London County Council, were to apply for powers to take the water for the whole of the Metropolis, it would meet probably with a very strong resistance?—I am certain it would. I would very much rather have to deal with the London County Council than with a Board.

The Commission then adjourned; the Chairman remarking that, in order to make progress, the Commission proposed to meet on Tuesdays, as well as on Mondays, and to sit an hour longer.

The twenty-eighth sitting of the Commission was held yesterday, at the Guildhall, Westminster—Viscount Llandaff presiding. Mr. Howard Martin, Chairman of the Water Committee of the Croydon Corporation, gave evidence regarding the water supply of that borough, which he said was derived from two sets of works, the total capital cost of which was £158,000. To meet the growth of population and the increasing consumption, certain extensions of the works were in contemplation. Croydon had always wished, and did so still, to supply the whole of their district themselves.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Edinburgh and Leith Gas Commission held their monthly meeting on Monday, with Lord Provost Mitchell Thomson in the chair. Bailie Kinloch Anderson, referring to the report of the Works Committee, said that during May, as compared with the same month of last year, there was an increased output of gas of between 3 and 4 million cubic feet, which, considering the season of the year, was quite satisfactory. The same Committee reported that they had let the contract for the taking down of the old chimney at the Edinburgh Gas-Works to Mr. W. J. Furse, of Nottingham. Bailie Kinloch Anderson said they had been exceedingly anxious to have this work done before the winter; and it was now quite likely that it would be accomplished. It is more than three years since the old chimney was discovered to be out of plumb, and the Commissioners resolved to have it taken down. In a conversation I had with the Engineer (Mr. W. R. Herring) last year, he informed me that the chimney would have to be taken down brick by brick, and most probably they would be sent down inside. The start of the work will be the most delicate part, as there is a very heavy iron top upon the chimney, in sections; and the tackle for their removal will require to be exceptionally strong. Mr. Herring has had experience of the work; and he says it will be necessary to encircle the chimney with chains, as, on account of its being rent nearly from top to bottom, there would be great danger of its falling outwards unless it were bound. The Works Committee also reported that they had arranged the series of deputations which are to visit gas-works in England and on the Continent, in view of the erection of the new works at Granton. The first three are to English works; and the fourth, to the Continent. It was further reported that the Broxburn Oil Company's offer of 2500 tons of oil had been accepted. Bailie Manclark, of Leith, moved that the annual accounts of the Commission, an abstract of which was published in last week's "Journal," should be remitted to the Finance and Law Committee to consider and report. The accounts, he said, showed the Commission to be in a very satisfactory financial position. In their first year, they had a surplus of £40,575; and for the past twelve months it was £54,994, with a balance of £12,110. When they remembered that they started the year with a deficit of £239, the result, he thought, was very satisfactory. The remit was made.

As to the accounts of the Commissioners, the first comment which may be made has reference to the marvellous vitality of the business. The increased output is more than 40 million cubic feet over 1896-7; and in that year, again, there was an increase over the preceding year of nearly 93 million cubic feet. In the year previous to that, the increase was 49 million cubic feet; and in the year before that, it was 103 millions. This is an increase of 285 million cubic feet during the space of four years. Since the Commissioners took over the undertaking, ten years ago, the output of gas has increased 406 million cubic feet, or over 26 per cent. But there is this other feature, which is equally gratifying—that the result has falsified the anticipations of those who predicted disaster to the finances on account of the resolution of the Commissioners last year to sell gas at a price only slightly under cost. In 1896-7, there was a deficit of £239, which, had it not been for the outlay on a new chimney for the Edinburgh Gas-Works, would never have existed, as there would have been a surplus of about £5000; and the Commissioners, having a large reserve fund, resolved to sell gas at what was estimated might be a slight loss, relying on being able to make up any deficit out of the reserve. But the year has more than paid its way. There is no deficit, but, on the other hand, a clear net profit on the year's working of £2601. The Commissioners, therefore, who knew their business, were more accurate than their journalistic and anonymous critics. In accounting for this exceedingly gratifying state of affairs, it is not to be left out of account that, under Mr. Herring's management, the quantity of gas sold per ton of coal carbonized has risen from 9360 cubic feet in 1895-6 to 10,200 cubic feet last year. In 1896-7, it was 9256 cubic feet; but the figures for that year were disturbed by the inclusion of the Portobello works, and the reading of the station meter there at a different period from Edinburgh and Leith. Thus 860 cubic feet more gas is being obtained from each ton of coal, which is a clear gain, and is practically a gift of 133½ million cubic feet of gas in the year to the Commissioners. Of course, there is now carburetted water gas, which helps up the quantity per ton of coal; but it was only a small amount—1373 tons of oil—so that the great bulk of the increased yield is clear gain. This is a pointed object-lesson in good management. I must not close this note, however, without the further remark that the Commissioners have part of the credit for the good management, for they give Mr. Herring a free hand in everything. There is the utmost confidence between them; and even more than that, there is a desire to further his schemes as much as possible. For one thing, Mr. Herring is most thoroughly supported by the Convener of the Works Committee (Bailie Kinloch Anderson), whose experience of gas-works management now goes back ten years, and who in the course of this period has thoroughly

mastered his duties. As to the finance department, it is almost unnecessary now to say that it is most admirably managed by the Treasurer (Mr. John S. Gibb). In this connection, I ought to mention the name of Mr. R. Cockburn, the Collector. His work is most efficiently done. I observe that in the year 1896-7, out of a revenue of £243,000, the bad debts only amounted to £335. It is with regret that I learn that Mr. Cockburn has, on account of ill-health, been laid aside from work, and that it has been found necessary to grant him leave of absence till October. In view of the fact that the Commissioners are about to take the serious step of transferring their works to a new site, it must be a comfort to all the citizens to know that the gas undertaking is in the keeping of a Committee and officials who work so harmoniously together, and whose ability is such that it is difficult to conceive of its being improved upon.

The effect of obtaining statutory powers by the Stirling Gaslight Company, Limited, is seen in the fact that, while it was only last week that the powers were obtained, the shares of the Company—formerly selling at £8 11s. 3d. per £4 share—cannot now be bought for £9 2s. 6d.

Following closely upon the settlement of the Stirling gas controversy, there has come this week the end of the difference between the Aberdeen Gas Committee and the Great North of Scotland Railway Company. The Railway Company have carried their Bill on conditions, which was what everyone outside the Gas Committee—and probably some within it, too—expected. In the House of Lords, the Bill passed on condition that if the Company took land, they should give the Corporation equivalent ground to the extent of 50 per cent. more. The proposal is to take 300 square yards off a corner of the gas-works site; and the ground proposed to be given is on the opposite side of a thoroughfare from the works. The terms which have been agreed upon, and which have been sanctioned by a House of Commons Committee, are that the Company are to give the Corporation 600 yards; that they are to pay them £1000, to be applied in the widening of a street; and that a bridge which crosses the railway is to be widened from 35 to 40 feet. Mr. Littler was in the midst of his opening address when a note was passed to him containing the terms of the compromise which had been come to by the parties; and, of course, the Bill passed unopposed. With regard to the settlement, it is to be noted that the Gas Committee have not been able to retain the gas-works intact. When the Railway Company proceed to effect the alterations they propose, the gas-works will be intersected by a public street. This is not a convenient arrangement; but that the inconvenience was not considered as of great moment is shown by the fact that, when terms were proposed, the Corporation representatives made no serious effort to avoid the partition of the works. In fact, one of the first things to be done was to produce a map which had been prepared by Mr. A. Smith, the Corporation Gas Engineer, in which it was shown how it would be necessary that the Corporation should get 600 yards of land; and the Railway Company agreed to the proposal. The other conditions agreed upon do not affect the gas-works, though they hung upon the proposed interference with the works; and I do not need to refer to them. I have no doubt Mr. Smith will be able to get out of any little difficulty which the division of his works may bring him into. In this belief, I can only say that the agreement is about as fair for both parties as it could have been made; but then it might have been effected months ago, and at home. It is well, however, that it has at last been arrived at.

The shareholders of the Hawick Gaslight Company met yesterday to consider the annual report of the Directors. The Chairman (Mr. Laidlaw, of Sillerbithall) said the Company had earned a profit of £1931, out of which it was proposed to pay a dividend at the rate of 10 per cent. It was also recommended that the price of gas should remain at 3s. 4d. per 1000 cubic feet. Prepayment meters were introduced during the past year. Already 108 were in use; and the number was increasing. In connection with these meters, he would like to see small cookers introduced, as they would be a great boon to the working classes, especially in the summer months. He was satisfied that, for cheapness and efficiency, incandescent gas lighting would be found to be preferable to electricity. He did not think there was a town in Scotland where gas of 28-candle power was produced at the same price as at Hawick. The original £5 shares of the Company, on which there is a guaranteed dividend of 10 per cent., are now selling at £12 each. The report was adopted.

The Saltcoats Gaslight Company are the owners of an undertaking which is not large, but which is in the hands of most capable people, both Directors and officials; and, as a consequence, it is one of the most flourishing gas companies to be met with. The annual balance-sheet is before me. It is a perfect model. Everything is set forth with a clearness which makes it easy for even the most uninitiated to follow the course of the business during the period dealt with. This period is not confined to the year, but, in different places, includes the results of years preceding, by which means the progress of the business is seen. Thus, in the report of the Directors, the quantity of gas made in various years is given. Then in a report which, I presume, must be the product of the Manager (Mr. J. Napier Myers) percentages of the output of gas for every year from 1893-4 are given. All of this, and much more, is most valuable information, not only to the Manager and officials, but also to the shareholders. The balance at the credit of the profit and loss account is £2233, of which £953 was the profit upon the past year. It is proposed to pay a dividend at the rate of 10 per cent., which will absorb £600, and to carry forward £1633. The dividend paid a year ago was 8½ per cent. The quantity of gas accounted for was 15,550,647 cubic feet; and the unaccounted-for gas was 6·93 per cent. The revenue from gas was £2533; and from residuals, £324. The coal consumed was 1720 tons, costing £796, and making, with £43 for cartage, a total cost of £839, or an average of 9s. 9·11d. per ton, 1s. 0·05d. per 1000 cubic feet of gas made, and 1s. 1·26d. per 1000 cubic feet of gas sold. The yield of gas was 9712 cubic feet per ton of coal.

The Bothwell and Uddingston Gas Company, Limited, had a balance of profit, upon last year's working, of £1900, after charging all renewals and bad debts. During the year they expended £200 upon a new laboratory and fittings and extending the mains, and paid £930 on account of a house which is being erected for Mr. Lawrence Hislop, the Manager. They issued 2500 new shares of £1 each, upon which £1171 premium was realized. Dividends at the rate of 10 per cent. upon both £15,750 of old stock and £2250 of new stock have been paid.

GAS AND WATER COMPANIES STOCK AND SHARE LIST.

Referred to on p. 43.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 15	10½	Alliance & Dublin 10 p. c.	23—24	..	4 7 6
100,000	10	,,	7½	Do. 7 p. c.	16—17	..	4 8 8
300,000	100	July 1	5	Australian 5 p. c. Db.	105—107*	+½	4 13 6
200,000	5	May 26	6	Bombay, Ltd.	5⅞—6¼	..	4 16 0
40,000	5	,,	6	Do. New, £4 paid	4½—5	..	4 16 0
380,000	Stk.	Feb. 24	12	Brentford Consolidated	280—285	..	4 4 3
240,000	,,	,,	9	Do. New	210—220	..	4 1 10
50,000	,,	,,	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
159,375	,,	June 10	4	Do. 4 p. c. Db. Stk.	130—135	..	2 19 3
230,000	Stk.	Mar. 30	11½	Brighton & Hove Orig.	268—273	..	4 4 3
218,820	,,	,,	8½	Do. A. Ord. Stk.	195—200	..	4 5 0
933,500	Stk.	Feb. 24	5	Bristol, 5 p. c. max.	127—132	..	3 15 9
430,000	20	Ma. 30	11½	British	54—55	−½	4 1 9
50,000	10	Mar. 11	11½	Bromley, Ord. 10 p. c.	25—27	..	4 5 2
75,000	10	,,	8½	Do. 7 p. c.	20—22	..	3 17 3
500,000	10	Apl. 29	6	Buenos Ayres (New) Ltd	9—9½	..	6 6 4
98,122	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	98—100*	+1	4 0 0
150,000	20	Mar. 11	8¼	Cagliari, Ltd.	30½—31½	..	5 4 9
100,000	10	June 10	7	Cape Town & Dis., Ltd.	15—16*	..	4 7 6
50,000	50	May 3	6	Do. 6 p. c. 1st Mort.	58—60	..	5 0 0
550,000	Stk.	Apl 15	13½	Commercial Old Stock	320—325	..	4 3 1
200,750	,,	,,	10½	Do. New do.	250—255	..	4 2 4
200,750	,,	June 10	4½	Do. 4½ p. c. Db. dc.	148—153	..	2 18 10
800,000	Stk.	June 10	12	Continental Union, Ltd.	205—210	..	5 14 3
200,000	,,	,,	9	Do. 7 p. c. Prf.	190—195	..	4 12 4
51,600	Stk	Feb. 24	14	Croydon A 10 p. c.	310—315	..	4 8 11
168,400	,,	,,	11	Do. B 7 p. c.	255—265	..	4 3 0
535,000	Stk.	Feb. 24	5½	Crystal Palace Ord. 5 p. c.	125—130	..	4 0 9
60,000	,,	,,	5	Do. 5 p. c. Prf.	142—145	..	3 9 0
486,090	10	Jan. 27	11	European, Ltd.	23¾—24½	..	4 9 9
364,060	10	,,	11	Do. £7 10s. paid	17—18	..	4 11 9
5,922,110	Stk.	Feb. 10	12½	Gaslight & Coke, A, Ord.	292—296	+1½	4 6 0
100,000	,,	,,	4	Do. B, 4 p. c. max.	118—123	..	3 5 1
665,000	,,	,,	10	Do. C, D, E, 10 p. c. Prf.	305—310	+3	3 4 6
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	150—155	..	3 4 6
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	220—225	..	3 6 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	195—200	..	3 10 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	303—308	+3	3 4 11
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	182—187	..	3 4 2
1,061,150	,,	June 10	4	Do. 4 p. c. Db. Stk.	131—133	+½	3 0 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	148—153	..	2 18 10
958,000	,,	,,	6	Do. 6 p. c. do.	198—203	..	2 19 1
70,000	10	May 12	8	Hongkong & China, Ltd.	13¼—14½	..	5 10 4
3,800,000	Stk.	,,	10	Imperial Continental	207—212	..	4 14 4
376,480	100	Feb. 1	4	Do. 4 p. c. Dbs. Red.	98—101	..	3 19 3
473,600	Stk.	Feb. 10	3½	Do. 3½ p. c. Db. Stk. ,,	103—106	..	3 6 0
540,000	100	Apl. 1	5	Met. of Mel- bourne 5 p. c. Db.	110—112	..	4 9 3
250,000	100	,,	4½	bourne 4½ p. c. Db.	107—109	..	4 2 7
					* Ex div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	June 29	6	Malta & Medn., Ltd.	4⅞—5¼*	..	5 14 3
541,920	20	June 10	5	Monte Video, Ltd.	14—15	..	6 13 4
617,946	Stk.	Feb. 24	9¾	Newc'tle & Gatesh'd Con.	235—240	..	4 1 8
252,355	Stk.	Jan. 8	3½	Do. 3½ p. c. Db. Stk.	115—120	..	2 18 4
150,000	5	May 26	8	Oriental, Ltd.	7½—8	..	5 0 0
135,000	5	,,	8	Do. New, £4 10s. pd.	6½—7	..	5 2 11
15,000	5	,,	8	Do. do. 1879, £1 pd.	1½—1⅝	..	4 11 5
60,000	5	Mar. 11	7	Ottoman, Ltd.	5—5½	+½	6 6 2
500,000	100	June 1	6	People's Gas 2nd M. of Chicago Bd.	103—108	..	5 11 1
848,070	10	May 26	6	River Plate Ord.	9—9½	..	6 6 4
250,000	Stk.	June 29	4	Do. 4 p. c. Db. Stk.	96—98*	..	4 1 8
250,000	10	Apl. 29	10	San Paulo, Ltd.	15—16	+½	6 5 0
135,000	Stk.	Mar. 30	10	Sheffield A.	245—248	..	4 0 8
209,053	,,	,,	10	Do. B.	245—248	..	4 0 8
447,427	,,	,,	10	Do. C.	245—248	..	4 0 8
5,531,250	Stk.	Feb. 24	5½	South Metrop., 4 p. c. Ord.	141—144	+2	3 12 11
1,460,000	,,	Jan. 13	3	Do. 3 p. c. Db. Stk.	101—104	+1	2 17 8
60,000	Stk.	Mar. 11	12	Tottenham and A. Edmonton B.	285—295	..	4 1 4
60,000	,,	,,	9		205—215	..	4 3 9
182,380	10	June 10	7	Tuscan, Ltd.	13—14	..	5 0 0
149,900	10	July 1	5	Do. 5 p. c. Dbs. Red.	100—103*	+2½	4 17 1
				WATER COMPANIES.			
746,164	Stk.	June 29	10½	Chelsea, Ord.	313—318*	−1¾	3 6 0
150,000	,,	,,	5	Do. 5 p. c. Prf.	170—175*	+½	2 17 2
160,000	,,	,,	4½	Do. 4½ p. c. Pf. Stk., 1875	148—152*	..	2 19 3
175,785	,,	Mar. 30	4½	Do. 4½ p. c. Db. Stk.	157—162	..	2 15 7
1,720,560	Stk.	Apl. 15	8	East London, Ord.	225—230	..	3 9 7
654,740	,,	June 29	4½	Do. 4½ p. c. Db. Stk.	157—160*	+¾	2 16 3
390,000	,,	,,	3	Do. 3 p. c. Db. Stk.	103—105*	+½	2 17 2
700,000	50	June 29	7½	G'd Junct'n, 10 p. c. max.	115—118*	..	3 8 7
210,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140—145	..	2 15 2
708,000	Stk.	Feb. 10	13	Kent	358—363	..	3 11 8
160,000	,,	,,	7	Do. New, 7 p. c. max.	218—218	..	3 4 3
1,043,800	100	June 29	10	Lambeth, 10 p. c. max.	295—300*	+2	3 6 8
406,200	100	,,	7½	Do. 7½ p. c. max.	225—230*	+¾	3 5 3
350,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140—145	..	2 15 2
500,000	100	Feb. 10	13	New River, New Shares	432—437	..	2 19 6
1,000,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	141—146	..	2 14 10
902,300	Stk.	June 29	6	Southw'k & V'xhall, Ord.	163—168*	+1	3 11 5
126,500	100	,,	6	Do. do. 7½ p. c. max.	152—156*	−½	3 16 11
489,200	Stk.	,,	5	Do. do. 5 p. c. Prf.	168—172*	..	2 18 2
1,019,585	,,	Apl. 15	4	Do. 4 p. c. A Db. Stk.	141—144	..	2 15 7
1,155,066	Stk.	June 10	10	West Middlesex	295—300	..	3 6 8
300,000	,,	,,	4½	Do. 4½ p. c. Db. Stk.	162—165	..	2 14 7
200,000	,,	Mar. 11	8	Do. 3 p. c. Db. Stk.	104—106	..	2 16 7
					* Ex div.		

The quantity of gas sold was 32,331,000 cubic feet—an increase of 1,209,000 cubic feet. The unaccounted-for gas amounted to 5·8 per cent., which, considering the extent of underground coal working in the district, is marvellously low. The quantity of coal carbonized was 3430 tons, as compared with 3463 tons in 1896-7.

The Cupar Gas Company have a balance at the credit of profit and loss account, as the result of the past year's working, of £794, which, with the sum brought forward, makes £972, out of which the Directors propose to pay dividends at the rate of 4 per cent., to set aside £224 for depreciation; to place £100 to the reserve fund; and carry forward £78. The Newmilns (Ayrshire) Gas Company have had a very prosperous year; and they have paid a dividend at the rate of 5 per cent. The Annan Gaslight Company had a revenue last year of £1872; and an expenditure of £1352. Out of the balance, £520, a dividend has been paid at the rate of 12s. per £10 share; and £100 has been placed to the insurance fund, which now stands at £500. The capital account amounts to £6337. The price of gas has been reduced from 4s. 2d. to 3s. 9d. per 1000 cubic feet. The Galashiels Gaslight Company have had a surplus of revenue upon the past year's working of £2051, which, with a balance of £5877 from the previous account, makes a sum of £7928 at the credit of the profit and loss account. The Directors propose to pay a dividend at the rate of 10 per cent., which will absorb £2100, and to carry forward £5828.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 2.

Sulphate of Ammonia.—There has been an active market, and a further improvement in values; and the closing quotations are £9 5s. per ton f.o.b. Hull, and £9 6s. 3d. per ton f.o.b. Liverpool and Leith. In the early part of the week, there was considerable anxiety in regard to uncovered contracts for June delivery; and all available parcels were eagerly picked up at full prices. July has opened with a somewhat quieter tone; but there is nothing pressing for sale, and meantime makers are very firm. A moderate amount of direct business has been done. But consumers have been inclined to regard the recent advance as temporary, and, consistently with that view, have not for the most part followed the market. In the forward position, prices required by makers have checked business; and there has been very little speculative offering. Business has been done over near months at about £9 7s. 6d. per ton; but £9 10s. f.o.b. Leith is required by Scotch makers, July-December and October-March delivery. The Beckton quotation, October-December delivery, is £9 5s. per ton, Beckton terms.

Nitrate of Soda is firm; and spot quotations are for ordinary quality 7s. 7½d. per cwt., and for refined 7s. 10½d.—refined quality being very scarce.

LONDON, *July* 2.

Tar Products.—This market appears to be thoroughly demoralized, especially with respect to the chief products—viz., pitch, benzol, and anthracene. Benzols are marked again lower. Business has been done at a price which would not leave makers more than 8d. for nineties benzols naked at their works; while "B" quality anthracene has been sold at 3½d., and small parcels are being offered at lower prices than this. At such figures, it does not, of course, pay to extract anthracene; and, when this is recognized by distillers, the production will be still further largely decreased. It is stated that the stocks of anthracene in this country at the moment are much lower than they have been for some years, and that this position will be much further accentuated at the end of the year. Carbolic acid is realizing a little more money; and there is an excellent business doing in it, while crystals are distinctly better, and moving off more freely. The market for solvent and other naphthas is moderately active at about the old rates.

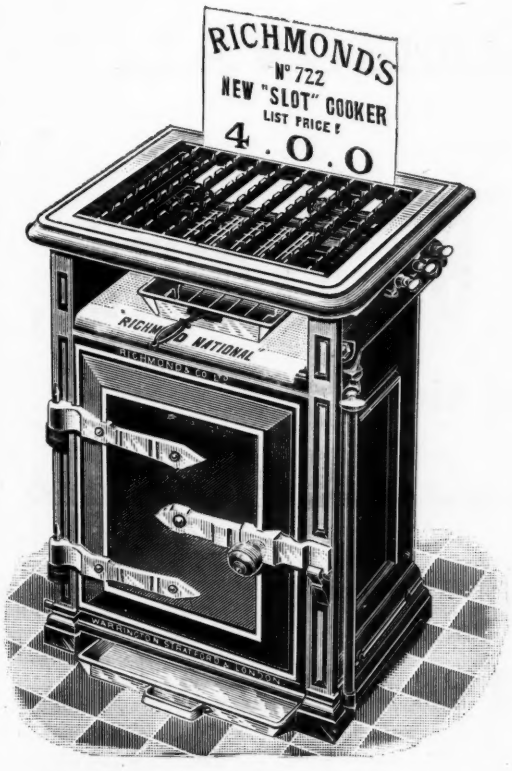
Business noted through the week averages as follows: Tar, 10s. to 14s. Pitch, 19s. to 22s. Benzols, 90's, 9d. to 10d.; 50's, 10½d. Toluol, 1s. 2d. Solvent naphtha, 1s. 2d. Heavy naphtha, 1s. 1½d. Crude, 30 per cent., naphtha, 4½d. Creosote, 2⅝d. Heavy oils, 50s. Carbolic acid, 60's, 2s. 1d. Naphthalene, 52s. 6d.; salts, 30s. Anthracene, "A," 4d. to 5d.; "B," 3d. to 4d.

Sulphate of Ammonia.—There is more inquiry for this article; and its position to-day is stronger. It is said that Beckton is out of the market, and well sold. To-day's average price is £9 5s., less 3½ per cent., in all positions, both for prompt and for forward delivery.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is nothing further of any very special importance to report with regard to gas-coal contracts, beyond what was referred to last week. One or two important contracts have been partially settled, on pretty much the same basis as that on which business has so far been put through—representing about 6d. per ton advance on the minimum figures of last year. But where collieries secured slight advances early in last season—which in some cases amounted to about 3d. per ton—they are simply putting on a further 3d. this year, making the two advances equal to 6d.; while those who obtained no advance last year are now generally holding out for 6d. per ton above the rates then accepted. There are, however, reports that in the Yorkshire districts some large quantities have been placed at only a very nominal advance over last year's prices; and this is tending to somewhat weaken confidence as to whether the full prices Lancashire coalowners are now asking will in all cases be obtained. One result certainly would seem to be that buyers of gas coal are showing extreme caution about placing their contracts; and there is no doubt that, owing to this, considerable quantities are still held in abeyance pending some further understanding as to prices. With regard to the locomotive fuel contracts, it is reported that the London and North-Western Railway Company were able to place about 130,000 tons outside the collieries with whom they have usually settled their contracts, and that this quantity of coal was arranged for at substantially under the figure that the combination of Lancashire coalowners asked, with the result that probably the average advance



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on their locomotive fuel contracts would not be much more than 6d. per ton all round over last year. Current business with respect to other descriptions of fuel continues very steady, with prices firm. Steam and forge coals and engine fuel are all maintaining full rates; and on forward contracts advances have been obtained of about 3d. up to 5d. per ton in some special cases on engine fuel, and generally about 6d. per ton on round coal. At the pit mouth, average quotations remain at 10s. to 10s. 6d. per ton for best Wigan Arley; 8s. 6d. to 9s., for seconds Arley and Pemberton four-feet; 7s. to 7s. 6d., for common house coal; 6s. 9d. to 7s. for steam and forge coal; 4s. 6d. to 5s., for best slack; 4s. to 4s. 3d., for medium; and about 3s. 6d., for the common sorts. Shipping has been rather quieter, with good qualities of steam coal not fetching more than 8s. 6d. to 9s. per ton delivered at the ports on the Mersey. As to the wages question, which is to be dealt with at a conference of Committees representing the Federated Coal Owners and Miners in London to-morrow (Wednesday), it is generally anticipated that some advance will be conceded without any serious opposition; but that possibly it may be divided into two instalments of 5 per cent. towards the close of the year, and a further 5 per cent. deferred to a later period. This is a proposal which, at any rate, has been discussed; but whether the Miners' Federation would be willing to accept such an arrangement is perhaps doubtful.

Northern Coal Trade.—There has been a very strong demand for coal; and though the supply has been adequate, prices are fairly firm all round. Best Northumbrian steam coals are quoted at 12s. 9d. per ton f.o.b., for early delivery; but any speedy settlement of the Welsh strike would bring down the prices. Second qualities of steam coals are about 11s. 9d. per ton; and steam smalls, being rather scarce, are firm at 5s. 3d. to 5s. 6d. In regard to gas coals, there is a steady demand, which is likely to increase weekly. For large contracts, the quotation is now on the basis of 17s. 9d. per ton f.o.b.; but for early delivery and for occasional cargoes, as high as 9s. per ton f.o.b. is quoted. At present, the exports of gas coals are large, both to the Mediterranean and to the northern ports; and they will continue so for some time to come. There is little or no alteration in the price of manufacturing coals; but the consumption is fuller than it was. Gas coke shows no change in prices.

Scotch Coal Trade.—There is little to be said about the coal trade in Scotland, except that it is still waiting the decision of the Welsh dispute. Questions have been raised in Parliament regarding the use of Scotch coal instead of Welsh coal in the Navy; but, to those who know, not much is expected to come of the bringing forward of the subject. Scotch coalowners will be well advised if they pay no attention to any movement to introduce their coal into the Navy. It has not sufficient calorific value for the supreme purpose for which such coal is required. Apart from this question, there is a large demand, almost more than the supply is equal to. The prices quoted are: Main, 8s. 9d. to 9s. per ton f.o.b. Glasgow; ell, 9s. 3d. to 9s. 6d.; and splint, 9s. 6d. The shipments for the week amounted to 237,707 tons—an increase of 864 tons upon the preceding week, and of 75,765 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,294,362 tons—an increase over the same period of last year of 743,125 tons.

New Joint-Stock Companies.—The Carluke Gas Company, Limited, has been registered with a capital of £10,000, in £1 shares, to carry on the business of gas and electric light supply. The O'Brien Flash-Light Syndicate, Limited, with a capital of £12,000, in £1 shares, will enter into an agreement with J. E. O'Brien, and carry on the business of mechanical engineers, lamp manufacturers, gas-fitters, plumbers, &c. The Monifieth Gas Company, Limited, was registered in Edinburgh, with a capital of £5000, divided into 1000 preference shares (4 per cent.) of £1 each, and 4000 ordinary shares of £1 each.

Ottawa Gas Company.—The report presented by the President of this Company (Mr. John Coates, M.Inst.C.E.) at the recent annual general meeting showed that the profit on the operations for the year ending March 31, exclusive of $2933 paid for repairs and renewals to retort-benches, which was charged to revenue, amounted to $30,257; being an increase of $2214 on the sum realized in 1896-7. The net profit was $25,391, out of which the Directors recommended a dividend of 7 per cent., amounting to $22,750. The increase in the consumption of gas for the year was 6,678,000 cubic feet, or equal to 18 per cent. This the Directors considered to be eminently satisfactory in face of competition by electricity produced by machinery driven solely by water power. On the 1st of April last, the commencement of the financial year, the price of gas was reduced from $1·75 to $1·50 per 1000 cubic feet to all consumers using it exclusively for lighting purposes. This will, of course, make a difference in the income, which the Directors hope will be covered by a greater output; and a further reduction will be experienced in consequence of the extension of electric lighting to the Government Buildings. The manufacturing plant was reported to be in excellent order; and the leakage has been considerably reduced.

Hull Water-Works Assessments.—At the meeting of the Hull Water-Works Committee last Friday, it was reported by the Town Clerk (Mr. E. Laverack) that Mr. Wellsted, the Arbitrator, had made his award in connection with the valuation assessments in the parish of Holy Trinity and St. Mary, and the parishes within the Sculcoates Union. It appeared that the rateable value of the property of the Committee in Holy Trinity and St. Mary at the present time is £3304. The original assessment was increased by the Overseers to £4183, and the amount at which the Corporation thought it ought to be put was £2338. It would therefore be seen that while the amount at which the Corporation thought the property should be assessed was under that fixed by the Referee, the figure at which the Overseers assessed it had been reduced by him by £879. With regard to the property of the Committee in the parishes within the Sculcoates Union, the amount at which it was originally assessed by the Overseers was £6233, which was increased by them to £10,831; and the amount at which the Corporation thought it ought to be put was £9783. It had been fixed by the Referee at £9933; being a reduction of £898. The Chairman complimented the Water Engineer (Mr. F. J. Bancroft) on the manner in which he had handled the business, and said the award was most satisfactory. The report was ordered to be entered on the minutes; and it was decided to withdraw the appeal of which notice had been given.

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Automatic Retort-House Machinery for the Jersey Gas-Works.—The New Conveyor Company, Limited, have received the order for the automatic machinery for the new retort-house and two new coal-stores at the Jersey Gas-Works. Mr. Morris, the Engineer and Manager at Jersey, inspected the new retort-house at Nelson last week, along with Mr. Gilbert Little, and saw in operation the coke elevators, conveyors, and coke storage hoppers recently completed there.

A New Reservoir at Neath.—Last Thursday, the Mayor of Neath (Mr. Abraham George), accompanied by the members and officials of the Corporation, inaugurated a new reservoir which has been constructed, in the picturesque valley known as the Moss House Dingle, from the plans of the Borough Engineer (Mr. D. M. Jenkins). The reservoir has been formed by throwing across the valley an embankment, which has a top level of 60 feet above the old bed of the valley, and about 400 feet above the town. The catchment area supplying the reservoir is about 330 acres in extent, principally open mountain land. With the Gnoll reservoirs, the Corporation have now storage room sufficient for a population of 20,000; the number at present served being 15,500. A sufficient supply for at least 30 years hence is thus ensured.

Sales of Shares.—Last Tuesday, Messrs. Catling and Son sold by auction £25 of consolidated 10 per cent. stock of the Cambridge Water Company for £81. On the same occasion, £6 of 10 per cent. stock and £10 of 7 per cent. stock of the Company fetched £40. At a recent sale of shares in the Deal and Walmer Gas Company, very high prices were reached. Five "A" (£10) shares realized £24 10s. each; five similar shares, £24 15s. each, ten "B" (£1 5s.) shares, 30s. apiece; twenty £10 "C" shares (£7 10s. paid), £17 5s. per share; ten similar shares, £17 each; and eight similar shares, £18 apiece. Messrs. Cooper and Wacher last Wednesday afternoon, at Canterbury, disposed of £1195 of "A" and "B" stock of the Canterbury Gas and Water Company. The stock, in £20 lots, realized an average of £42 to £43 per lot.

East Stonehouse Water Supply.—The arrangement under which the district of East Stonehouse will in future obtain its water supply from the water-works of the Plymouth Corporation was carried out last week. Formerly the governing body of the township owned an independent service; and the Devonport Water Company had also the right to supply part of the township, including various Government establishments. Owing to the extension of building operations, the reservoirs belonging to the Local Board became liable to pollution; and in 1893 application was made to Parliament for power to obtain water from another source. Opposition was offered by the Plymouth Corporation and the Devonport Water Company. As the result of negotiations, however, an arrangement was entered into by which Plymouth undertook to supply for two years a million gallons of water per week at the price of 2½d. per 1000 gallons; for the succeeding three years, a supply of 750,000 gallons at the same price; and afterwards, 500,000 gallons per day in perpetuity—the price to be reduced from 2½d. to 1d. per 1000 gallons at the expiration of sixty years. The five years having expired, the full service of 500,000 gallons a day was inaugurated last week, when the Company were paid £11,750, the compensation agreed upon for the transfer of their rights to the East Stonehouse District Council. By a recent arrangement with the Plymouth Corporation, the District Council have been relieved of the cost of laying a separate main to the Corporation reservoir at Hartley, which was the original intention; and, instead of this, the Plymouth Corporation have put down a special main to the boundary of the district, where it is connected with the Stonehouse mains—a meter being fixed at the junction to register the supply, and a pressure-valve to regulate the pressure, which is to be equal to 80 lbs. per square inch in the Stonehouse district. For the additional facility of the new main, the District Council are to pay the Corporation a further sum of £200 per annum, which is to be eventually reduced to £150. The ceremony of turning on the new supply took place yesterday week. Mr. J. C. Wills, the Chairman of the East Stonehouse Water Committee, shut off the old valve; and Master S. Vosper, on behalf of his father, the Chairman of the District Council, turned on the new supply. The Water Engineer of the Council is Mr. A. W. Debnam.

The Lighting of the Ipswich Workhouse.—After much discussion, which has been going on at intervals since last December, the Ipswich Guardians have come to a decision as to the lighting of the new Workhouse. Electricity and gas have each had their partisans; and at the close of the past year a resolution was passed to adopt the former illuminant. Then the question was re-opened; and at the meeting last Friday Mr. Sizer moved the rescission of the resolution—expressing the hope that the vexed question of electricity or gas would be settled once for all. His motion, however, was lost by 13 votes to 11. Then came a long report from the Workhouse Erection Committee, who, in accordance with instructions, had considered two points—(1) to what extent their estimate as to the cost of lighting the Workhouse by gas would be modified by the adoption of the most recent improvements; and (2) whether it would not be advisable to generate electricity by steam rather than by gas. The only improvements in lighting by gas which, in the opinion of the Committee, were worth consideration were those effected by Welsbach burners and mantles. To light the Workhouse fairly well would require 451 burners at least. The total cost arising from installing the gas according to this system would be £1262. The annual cost they put at £208. On the second question, Mr. Jolliffe, the Engineer and Secretary of the Ipswich Gas Company, advised three small gas-engines instead of one large engine—using one, two, or three, according to the amount of lighting required; and that they should have no accumulators. If this suggestion were adopted, the initial cost would be £2485, and the annual cost £222. The Committee recommended that the new Workhouse should be lighted by electricity generated by means of gas-engines. The adoption of the report having been moved and seconded, Mr. Sizer criticized the figures put forward by the Committee, which he said were unreliable. The cost would be at least £100 more than they had stated. He complained that the Gas Company had not been fairly treated; and he gave details of his estimate for lighting the Workhouse by gas, which showed an initial cost of £700, and an annual expense of £150, against £370 for the electric light. Mr. Calver, while acknowledging that this light was a good thing, said it was a luxury upon which the Board were not justified in spending so much money upon it. After some further conversation, the report was adopted by 16 votes to 8.

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WINDSOR STREET WORKS, BIRMINGHAM	2,000,000
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SWINDON (New Swindon Gas Co.)	120,000
SALTLEY WORKS, BIRMINGHAM (Second Contract)	2,000,000
WINDSOR STREET WORKS, BIRMINGHAM (Second Contract)	2,000,000
HALIFAX	1,000,000
TORONTO	250,000
OTTAWA	250,000
LINDSAY (Remodelled)	125,000
TORONTO (Second Contract; Remodelled)	2,000,000
MONTREAL	500,000
BELLEVILLE	250,000
OTTAWA (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000
ST. CATHERINES (Remodelled)	250,000
KINGSTON, PA.	125,000
PETERBOROUGH, ONT.	250,000
WILKESBARRE, PA.	750,000
ST. CATHERINES (Second Contract)	250,000
BUFFALO, N.Y.	2,000,000
WINNIPEG, MAN.	500,000
COLCHESTER (Second Contract)	300,000
YORK	750,000
ROCHESTER	500,000 Cubic Feet.

Further Borrowing Powers for the Manchester Gas Department.—At their meeting to-day, the Manchester City Council will be asked by the Gas Committee to sanction an application to the Local Government Board for permission to borrow the sum of £36,956 for additional gas meters and stoves.

The New Concession of the Anglo-Romano Gas Company.—In the "JOURNAL" for the 3rd of May (p. 1016), we gave the terms of the new concession of the above-named Company. It was recently submitted to the shareholders at an extraordinary meeting, and was approved. In the course of the discussion which took place, a shareholder proposed that in future the sum to be carried annually to the reserve fund should be reduced from 15 to 5 per cent. of the net profits, and that the fund should not exceed 20 per cent. of the capital. The proposal failed.

A Libel Action Settled.—Some time ago, Mr. Maurice Graham brought an action against Mr. Gilbert Little and the New Conveyor Company, Limited, in respect of a libel published by them with regard to Mr. Graham and his connection with the Company. We learn from that gentleman's Solicitors (Messrs. Church, Rendell, Todd, and Co.) that Mr. Little has now signed an ample apology in their client's favour, admitting that there was no foundation for any of the statements made in the libellous letter, and paying him an agreed sum for damages, as well as the whole of his costs as between solicitor and client.

The new issue of £20,000 of debenture stock of the Crystal Palace District Gas Company which Mr. Alfred Richards offered at the Mart last Wednesday was not sold; but he was subsequently successful in placing the whole of it at £152 per £100.

Exhibitions of the Welsbach Incandescent Gas-Light Company's new burner have recently been held in Leeds and Newcastle-upon-Tyne, under the direction of Mr. J. H. Sheldrake. In the latter case, the exhibition was opened by the Sheriff (Mr. J. F. Weidner).

Messrs. Bemrose and Sons, Limited, of London and Derby, have issued, at the price of 1d., a "People's Guide to the Workmen's Compensation Act." It is by Mr. R. M. Minton-Senhouse and Mr. G. F. Emery, LL.M., both of whom are members of the Inner Temple; and their aim has been to produce a work which will be useful to those who have no facilities for referring to ordinary text-books.

Messrs. R. & A. Main, Limited, have lately held a most successful exhibiti on at the Mechanics' Institute, Lindley, near Huddersfield. The audienceeach day numbered about 300; and afternoon tea was served gratis. Miss Baines, of the Manchester School of Cookery, gave cookery demonstrations twice daily. In conjunction with the Gas Department of the Birmingham Corporation, Messrs. W. Parkinson and Co. held a gas exhibition from the 27th ult. to the 1st inst. in the Victoria Hall, Aston; cookery lectures being given twice daily by Miss Edith Sanderson.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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[For Illustrated Advertisement, see p. 73.]

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Applications for either of the above vacancies, stating Age, Experience, Qualifications, &c., with *copies* of not more than four recent Testimonials, to be addressed to the Secretary so as to reach him not later than Tuesday, July 12, 1898.
J. A. PATTULLO,
Secretary.
Pará (New) Gas Company, Limited,
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Address J. THOMPSON, Norfolk Street, Glossop, near MANCHESTER.

FOR SALE—A Second-hand (thoroughly overhauled) Vertical PUMP EXHAUSTER, with Steam-Engine (with clean Water and Liquor Pumps attached), to pass 7000 cubic feet of Gas per hour.
Apply to R. DEMPSTER AND SONS, LIMITED, Elland, YORKS.

FOR SALE—One (nearly new) Waller's Patent Three-Blade Beale improved GAS EXHAUSTER, 12 in. diam. by 12 in. long, with tight and loose Pulleys, capable of exhausting 5000 cubic feet per hour.
For Price, &c., apply to G. S. DE RITTER, 33, Three Colt Street, LIMEHOUSE, E.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

FOR SALE, Cheap—The under- mentioned GAS PLANT:—
2 PURIFIERS, 8 ft. square by 4 ft. deep, complete.
2 PURIFIERS, 5 ft. square by 4 ft. deep.
1 PURIFIER, 5 ft. square by 2 ft. 9 in. deep.
CONDENSER, 4 inches diameter, Vertical Pipes.
EXHAUSTER (Gwynne's), 20,000 c. f. per hour.
Apply to SAML. WHILE AND SONS, 60, QUEEN VICTORIA STREET, E.C.

BOROUGH OF ROTHERHAM.
(GAS DEPARTMENT.)

TO BUILDERS.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for the CONVERSION of an existing Gasholder Tank into a TAR and LIQUOR STORAGE WELL, and also for the putting in of FOUNDATIONS for New Purifiers.
Plans and Specifications may be seen upon application to Mr. F. A. Winstanley, Engineer, Gas Offices, Rotherham.
The Contractor must not pay less than the Standard Rate of Wages paid in the district, and must observe the proper conditions of labour, and no sub-contracting will be allowed, except by permission of the Corporation.
Tenders to be delivered to me on or before the 20th inst., endorsed "Liquor Tank."
By order,
H. H. HICKMOTT,
Town Clerk.
Council Hall, Rotherham,
July 1, 1898.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

SPENT OXIDE.

THE Gas Committee invite Tenders for the purchase of about 300 Tons of SPENT OXIDE at their Regent Road and Bloom Street Works.
Full Particulars may be obtained on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Spent Oxide," and addressed to the Chairman of the Gas Committee, to be delivered to me not later than Three p.m., on Thursday, July 14, 1898.
By order,
SAML. BROWN,
Town Clerk.
Town Hall, Salford,
June 29, 1898.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

GENERAL STORES.

THE Gas Committee invite Tenders for the supply of the following MATERIALS, in such quantities as may be required, during the Twelve Months from date of acceptance of Tender, viz.:—

1. Wrought Iron and Steel.
2. Lead Pipe, Block Tin, Tubing, &c.
3. Bolts, Nuts, Rivets, and Meter Screws, &c.
4. Iron Castings, Cast-Iron Pipes, &c.
5. Gun Metal Meter Taps and Keys and Brass Lamp Taps.
6. Wrought-Iron Steam and Gas Tubing and Sundry Fittings.
7. Gas-Meters.
8. Paints, White and Red Lead, &c.
9. Chandlery.
10. Oils and Tallow.
11. Cotton Waste.
12. Cement and Lias Lime.
13. Timber.
14. Ropes, Yarn, and Twine.
15. Steel Shovels, Galvanized Iron Scoops and Buckets.
16. Brushes.
17. Testing and Repairing of Weighing-Machines.
18. Phosphor Bronze and Gun Metal Fittings for Meters.
19. India-rubber Rings, &c.

Forms of Tender and all Information may be obtained, and Samples seen, on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Stores," addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered to me not later than Three p.m., on Thursday, July 14, 1898.
By order,
SAML. BROWN,
Town Clerk.
Town Hall, Salford,
July 4, 1898.

SOUTHPORT CORPORATION GAS DEPARTMENT.

THE Gas Committee invite Tenders for the supply of GAS-METERS—Wet and Dry—for a period of Twelve Months from July 1 next.
Tenders, endorsed "Meters," to be in the hands of the Town Clerk, Town Hall, Southport, not later than Noon, on Tuesday, July 12 next.
JOHN BOOTH,
Gas Engineer.

NEW MILLS URBAN DISTRICT COUNCIL.

THE Gas Committee of the New Mills Urban District Council are prepared to receive TENDERS for the erection of a SULPHATE PLANT at their Gas-Works.
Full Particulars and Specifications may be obtained from the Engineer, Mr. E. Jones.
Tenders to be sent in to the undersigned not later than July 13, 1898.
JOSEPH POLLITT,
Clerk.
Town Hall, New Mills,
July 1, 1898.

BOROUGH OF CHORLEY.

THE Chorley Corporation are prepared to receive TENDERS for the supply of the following for their Gas-Works, viz.:—
GAS COAL 8000 Tons / LIME 100 Tons / VITRIOL 80 Tons } For Twelve Months from the 1st of September next.
Forms of Tender for Coal and Vitriol and any further Information may be obtained on application to Mr. John M'Cubbin, Gas Manager.
Tenders, duly endorsed, to be sent to me on or before Tuesday, the 12th inst.
By order,
JNO. MILLS,
Town Clerk.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)

COAL AND CANNEL.

TENDERS are invited for the supply of 3000 Tons of CANNEL, and 25,000 Tons of COAL (Screened or Through-and-Through) and SLACK.
Sealed Tenders, endorsed, addressed to the Chairman of the Gas Committee, Gas Offices, Warrington, must be sent in not later than the 21st inst.
Further Particulars can be obtained on application to Mr. W. S. Haddock, Engineer to the Works.
FREDK. TAYLOR,
Secretary.
Gas Offices, Warrington,
July 1, 1898.

BOROUGH OF HEYWOOD.

THE Gas Committee invite Tenders for the supply of LIME, TUBES and FITTINGS and SULPHURIC ACID.
Specification and Form of Tender may be obtained from Mr. W. Whatmough, Gas Manager.
Contractors tendering for this work must pay their workpeople at least the Standard or Trade Union Rates of Wages, and observe the trade conditions which attach to the various kinds of work for which the Tender is sent in.
Sealed and endorsed Tenders to be sent to me not later than Tuesday, July 19, 1898.
By order,
J. H. BALDWICK,
Town Clerk.
Municipal Buildings, Heywood,
July 1, 1898.

BRIDGNORTH CORPORATION GAS-WORKS.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee are prepared to receive sealed TENDERS for the supply of GAS COAL, including carriage to the Bridgnorth Railway Station, for One Year from, or soon after, the end of July next.
Evidence as to the quality of the Coal must accompany each Tender.
Quantity required: About 2200 Tons in proportionate deliveries as directed—say, 70 per cent. during Winter Months, and 30 per cent. during Summer Months.
Sealed and marked Tenders must be sent to the undersigned not later than Saturday, the 9th of July.
The Committee reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any Tender.
By order,
J. H. COOKSEY,
Town Clerk, Secretary.
Bridgnorth, June 24, 1898.

ATHERTON URBAN DISTRICT COUNCIL.

THE Gas Committee of the above Council are prepared to receive TENDERS for the following:—
CONTRACT No. 1—GAS CONDENSER, VALVES, and CONNECTIONS.
CONTRACT No. 3—Work and Materials required in the construction of a TELESCOPIC GASHOLDER, 52 feet in diameter.
The Drawings may be seen at my Office, and at the Office of Messrs. Thomas Newbigging and Son, Engineers, 5, Norfolk Street, Manchester.
Copies of the Conditions of Contract No. 1 and of the Bill of Quantities of Contract No. 3, together with Forms of Tender, may be obtained from the said Engineers on deposit of One Guinea for each Contract, which will be returned on receipt of a *bond-fide* Tender.
Sealed Tenders to be delivered to me not later than Thursday, the 14th day of July, 1898.
The Council do not bind themselves to accept the lowest or any Tender.
DANIEL SCHOFIELD,
Clerk.
District Council Offices, Atherton,
July 1, 1898.

TENDERS FOR COAL.

THE Directors of the Holyhead and North Wales Gas and Water Corporation, Limited, are prepared to receive TENDERS for the supply and delivery of COALS to their various Works for the ensuing Year.

Full Particulars and Forms of Tender may be had on application to the undersigned, to whom sealed Tenders, endorsed "Tender for Coal," must be sent not later than Twelve noon, Monday, July 11, 1898.

GEORGE E. SAVILLE,
Engineer and General Manager.

Conway Road, Penmaenmawr,
June 24, 1898.

TO COLLIERY PROPRIETORS.

THE Directors of the Sheffield United Gaslight Company invite TENDERS for GAS COAL, NUTS, and CANNEL for delivery during Twelve Months to the 30th of June, 1899.

The Quantities required will be approximately—

Gas Coal and Nuts . . . 185,000 Tons.
Cannel . . . . . 20,000 „

Tenders (forms for which can be obtained on application) must be delivered to the undersigned by post not later than the first post on Saturday, July 16.

The Directors do not bind themselves to accept the lowest or any Tender.

HANBURY THOMAS,
General Manager and Secretary.

Commercial Street, Sheffield,
June 25, 1898.

SOUTH SHIELDS GAS COMPANY.

TO METER MANUFACTURERS.

THE Directors of the South Shields Gas Company invite TENDERS for the supply of DRY GAS-METERS required during the Year ending the 30th of June, 1899.

The Meters must be of best quality, stamped, and delivered at the Gas-Works, carriage paid.

The Directors do not bind themselves to accept the lowest or any Tender.

Form of Contract and further Particulars may be had on application.

Sealed Tenders, marked "Tenders for Meters," to be delivered to the undersigned not later than Thursday, the 14th of July next.

J. H. PENNEY,
Secretary.

Gas Offices, Chapter Row, South Shields,
July 4, 1898.

LEIGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee of the above Council invite TENDERS for the supply of 10,000 Tons of GAS COAL and 1000 Tons of CANNEL, for the Year ending the 31st of July, 1899.

Forms of Tender may be obtained on application to the Manager at the Gas-Works.

Sealed Tenders, addressed to me, and endorsed "Tender for Gas Coal" or "Cannel" (as the case may be), to be delivered at my Office by Twelve o'clock noon on Monday, July 18 next.

The Council do not bind themselves to accept the lowest or any Tender, and may accept any Tender for a part only of the specified quantity.

By order,
PEREGRINE THOMAS,
Clerk to the Council.

Town Hall, Leigh, Lancs.,
June 30, 1898.

HINCKLEY URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE above Council invite Tenders as follows:—

COAL—For the supply of 5,000 Tons of COAL during the Year ending June 30, 1899.

LIME—For the supply of about 200 Tons of LIME for Purification purposes during the Year ending June 30, 1899.

TAR—For the purchase of the Surplus TAR produced at their Gas-Works during the Year ending June 30, 1899.

Forms of Tender and further Particulars may be obtained on application to the Engineer and Manager, Mr. Fred. Lee.

Sealed and endorsed Tenders to be sent to the undersigned not later than Monday, the 11th day of July, 1898.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
J. W. PRESTON,
Clerk.

Hinckley, June 24, 1898.

TO CAPITALISTS AND OTHERS.

SWANSEA, GLAMORGANSHIRE.

MESSRS. JOHN M. LEEDER & SON have received instructions from the Directors of the Swansea Gaslight Company to offer FOR SALE by Public Auction, at the Royal Hotel, High Street, Swansea, on Friday, the 22nd day of July, 1898, at 2.30 for 3 o'clock precisely in the Afternoon

£20,000 NEW ORDINARY STOCK, 1898,

in the Swansea Gaslight Company, in 250 Lots of £100 and £50 each respectively; being part of the Additional Capital of the Company authorized to be raised by the Swansea Gas Act, 1898, and pursuant to the Provisions and Conditions therein contained.

The Consolidated Stock 1898 and the New Ordinary Stock 1898 are entitled to receive Dividends at the rate of £5 in respect of every £100 of such Capital authorized by the Act; and such Stocks rank equally with each other in all respects.

Purchasers of this Stock will be entitled to receive Dividends as from the 1st day of July inst.

Particulars and Conditions of Sale containing all necessary Information may be obtained on application to the AUCTIONEERS, at their Offices, Goat Street Chambers, SWANSEA, or of THORNTON ANDREWS, Esq., Secretary and Manager to the Swansea Gaslight Company, Oystermouth Road, SWANSEA.

SKIPTON GAS COMPANY.

THE Directors of this Company are prepared to receive TENDERS for the supply and delivery of the following MAINS, coated:—

10-inch, 600 yards, or thereabouts.
6-inch, 600 „ „
3-inch, 400 „ „

Together with any SPECIAL CASTINGS that may be required.

Endorsed Tenders to be delivered to me not later than Tuesday, July 12 next.

The lowest or any Tender will not necessarily be accepted.

J. HAIGH,
Secretary.

Gas Office, Skipton,
June 27, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

BRENTFORD GAS COMPANY.

£15,000 OF NEW STOCK 1881.

Ranking for a Standard Dividend of 7 per cent. per annum subject to the Sliding-Scale; the last Dividend on similar Stock having been at the rate of 9 per cent.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, July 18, at Two o'clock precisely, in Lots.

Particulars may be obtained of the SECRETARY of the Company, at the Offices, BRENTFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executors of the late G. E. Wood, Esq.

IMPORTANT SALE OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday, July 25, 1898, at Two for half-past Two o'clock, in Lots, STOCKS AND SHARES as follows:—

WALTON-ON-THAMES AND WEYBRIDGE GAS COMPANY.—£1480 DEBENTURE STOCK and 200 £10 "A" and "B" SHARES.

HAMPTON COURT GAS COMPANY.—£1000 DEBENTURE STOCK and 140 £10 "A" and "B" SHARES.

PETERSFIELD GAS COMPANY, LIMITED.—100 £5 SHARES.

KINGSTON-ON-THAMES GAS COMPANY.—£100 DEBENTURE STOCK and three £50 SHARES.

WEST SURREY WATER COMPANY.—36 £10 SHARES.

SUNBURY GAS CONSUMERS' COMPANY.—68 £5 SHARES.

WOKING DISTRICT GAS COMPANY.—50 £5 SHARES.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

GAS PURIFICATION BY
HYDRATED OXIDE.

THIS Material is of full Strength, and Exceptional Activity. It is specially prepared to minimize Back-Pressure; and will be supplied on Hire, or Sold, on the most favourable Terms.

SPENT OXIDES containing Blue, also CRUDE FERRO-CYANIDE PRODUCTS, either PURCHASED or EXCHANGED for FRESH OXIDE.

MANCHESTER OXIDE COMPANY, LTD.,
CANAL ST., MILES PLATTING, MANCHESTER.

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The Meter Life Book specially adapted, and revised for "Slot" Meter Registration by

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In sizes to record 1000 Meters, with

Index, Half Bound	£2	2	0
To record 500 Meters	£1	15	0
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ALLERTON BYWATER, CASTLEFORD.

Steam, Manufacturing, & Gas Coals & Cannel.

Analysis, Contracts, Trial Waggons, and Quotations for Large and Small Orders. Inquiries Solicited.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

LONDONDERRY GAS COALS
FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

Lanemark Coal Co.,
LIMITED.

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AND GAS COALS.

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Shipping Ports: All the principal Scotch Ports.

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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY
Shipments Promptly and Carefully Executed.

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HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.

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CHESTERFIELD.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
Note.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers and rendering leakage impossible.

WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees:
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— LIMITED, —
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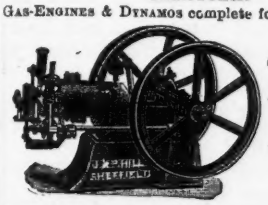
"OTTO" TYPE GAS-ENGINES
½ H.P. to 20 H.P. Specially designed for Users of Small Power.
Gas-Engines & Dynamos complete for Hotel, House, and Shop Installations.
Gas-Engines and Pumps.
High-Class Workmanship.



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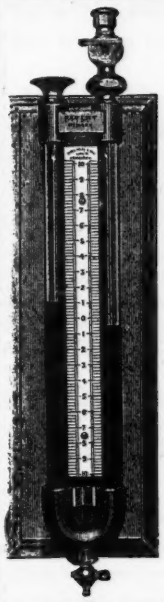

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Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
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Manufacture & supply best quality of
Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)
Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.
FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c., &c.
EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.
London Agents: Contractors for the erection of Retort-Benches complete.
BALE & HARDY, Gas Engineers and Contractors, BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
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W. RICHARDSON, Fitter.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

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OUT OF THEIR
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Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . . 10,500 Cub. Ft.
Illuminating Power . . 16·9 Candles.
Coke (of good quality) . . 67·5 per Cent.
Sulphur . . . . . 0·58 „
Ash . . . . . 2·78 „

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
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HOLMSIDE GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
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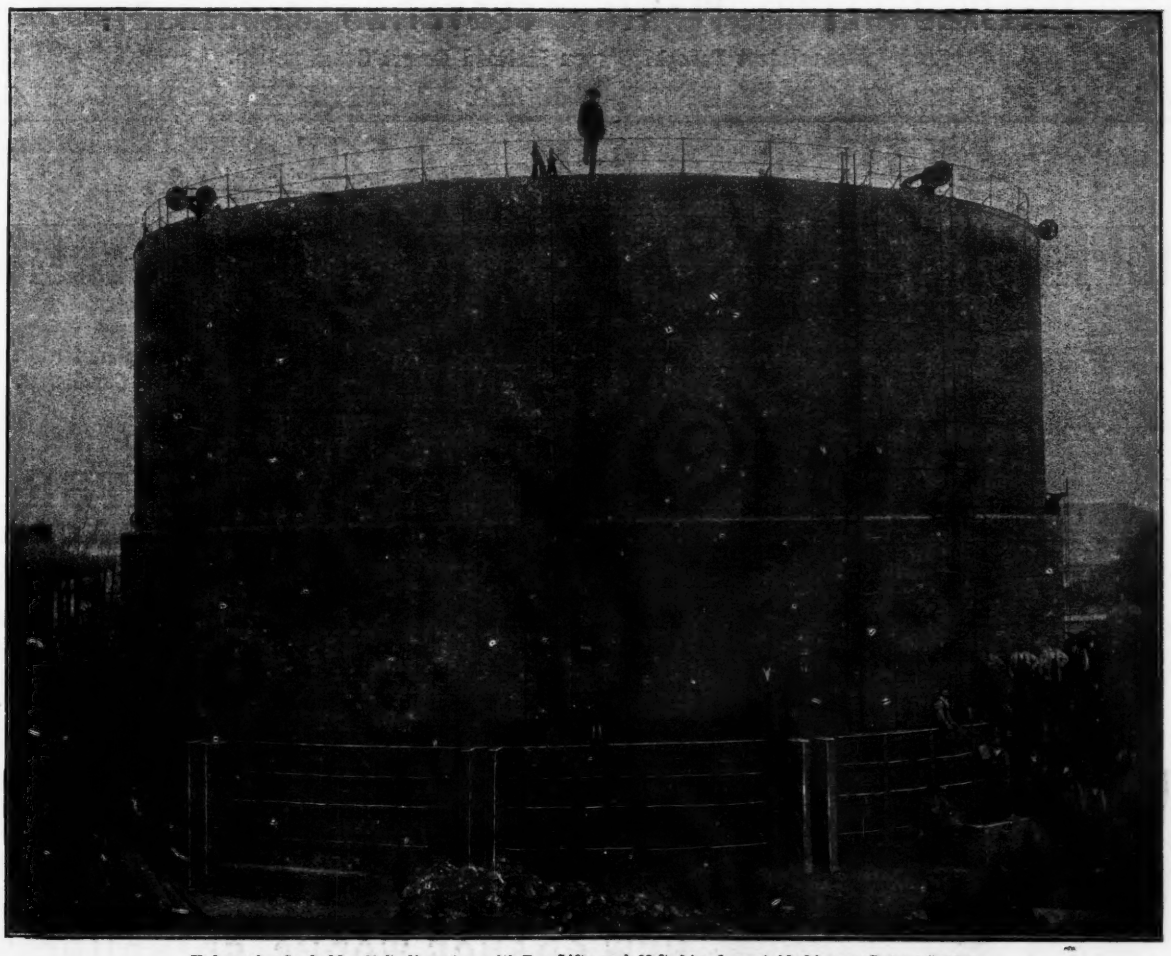

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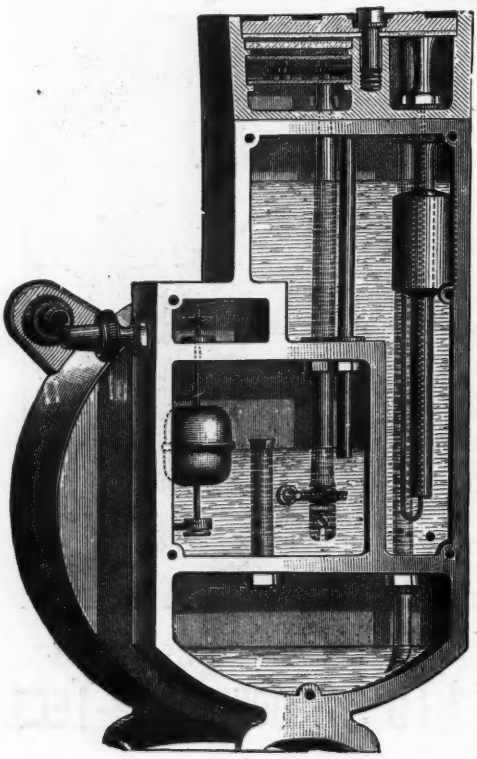

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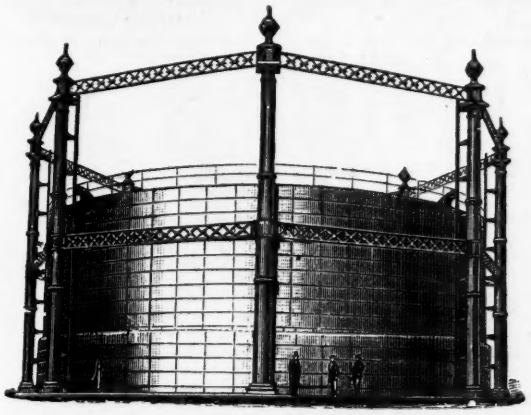

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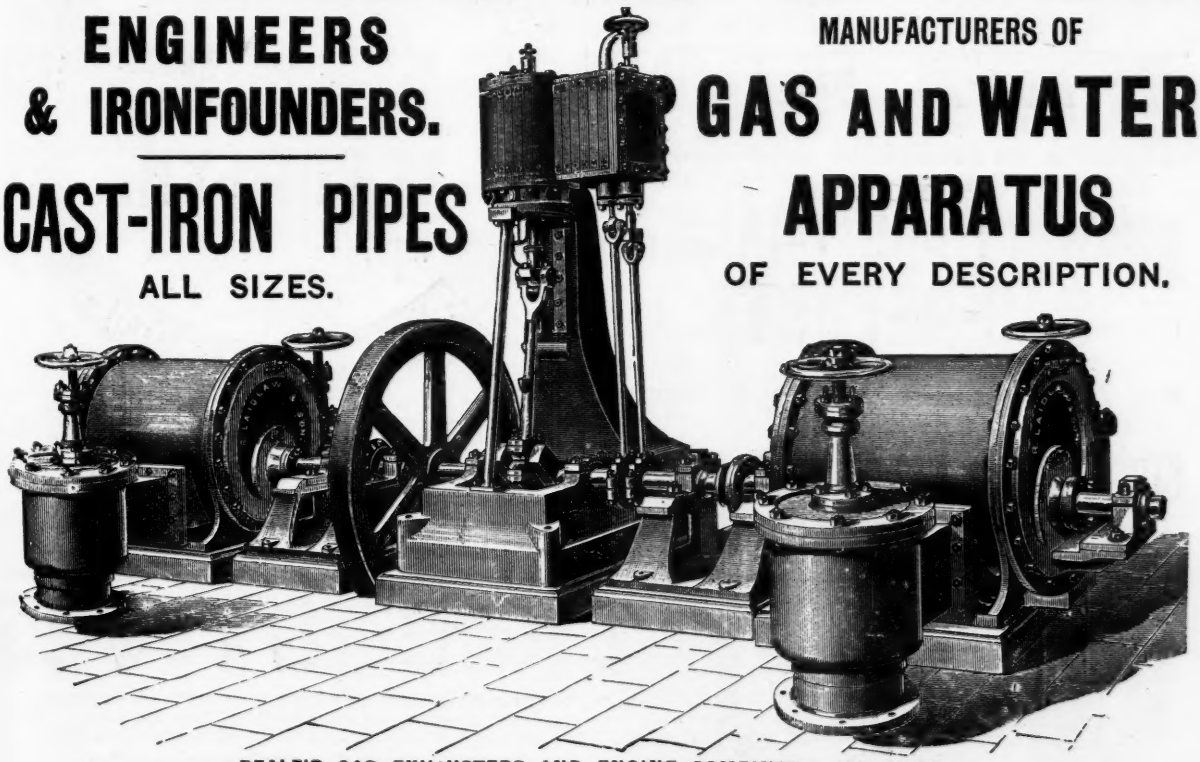

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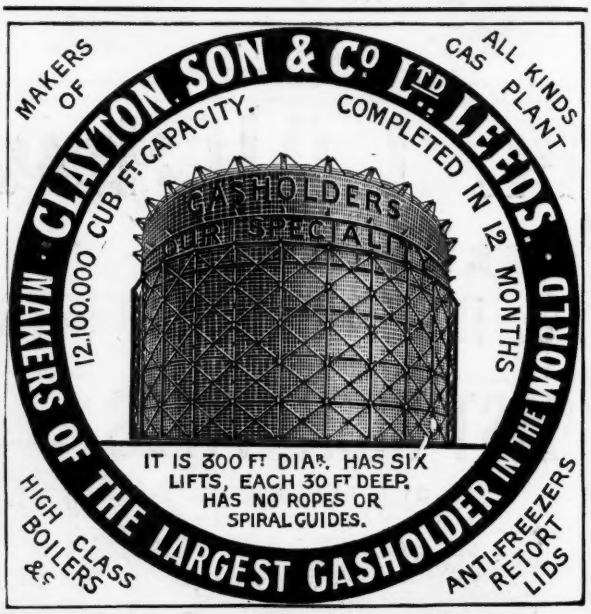
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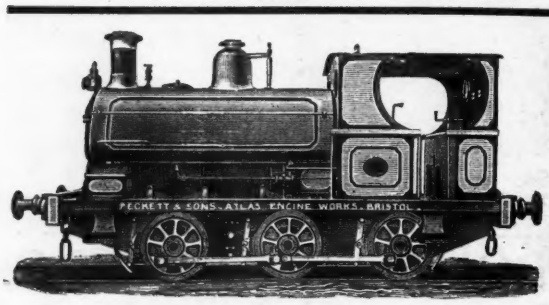

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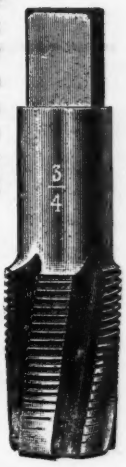

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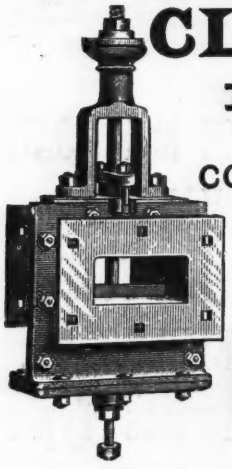

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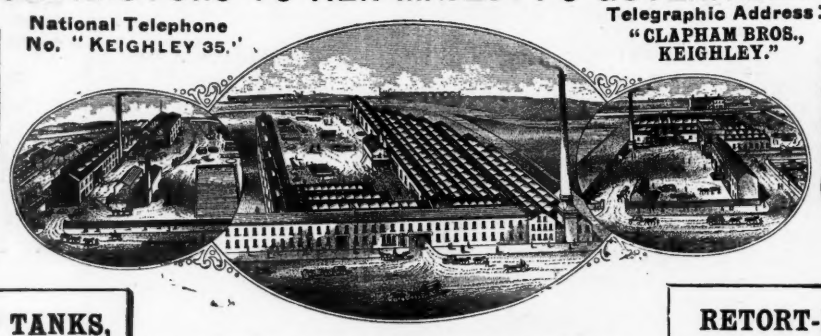

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